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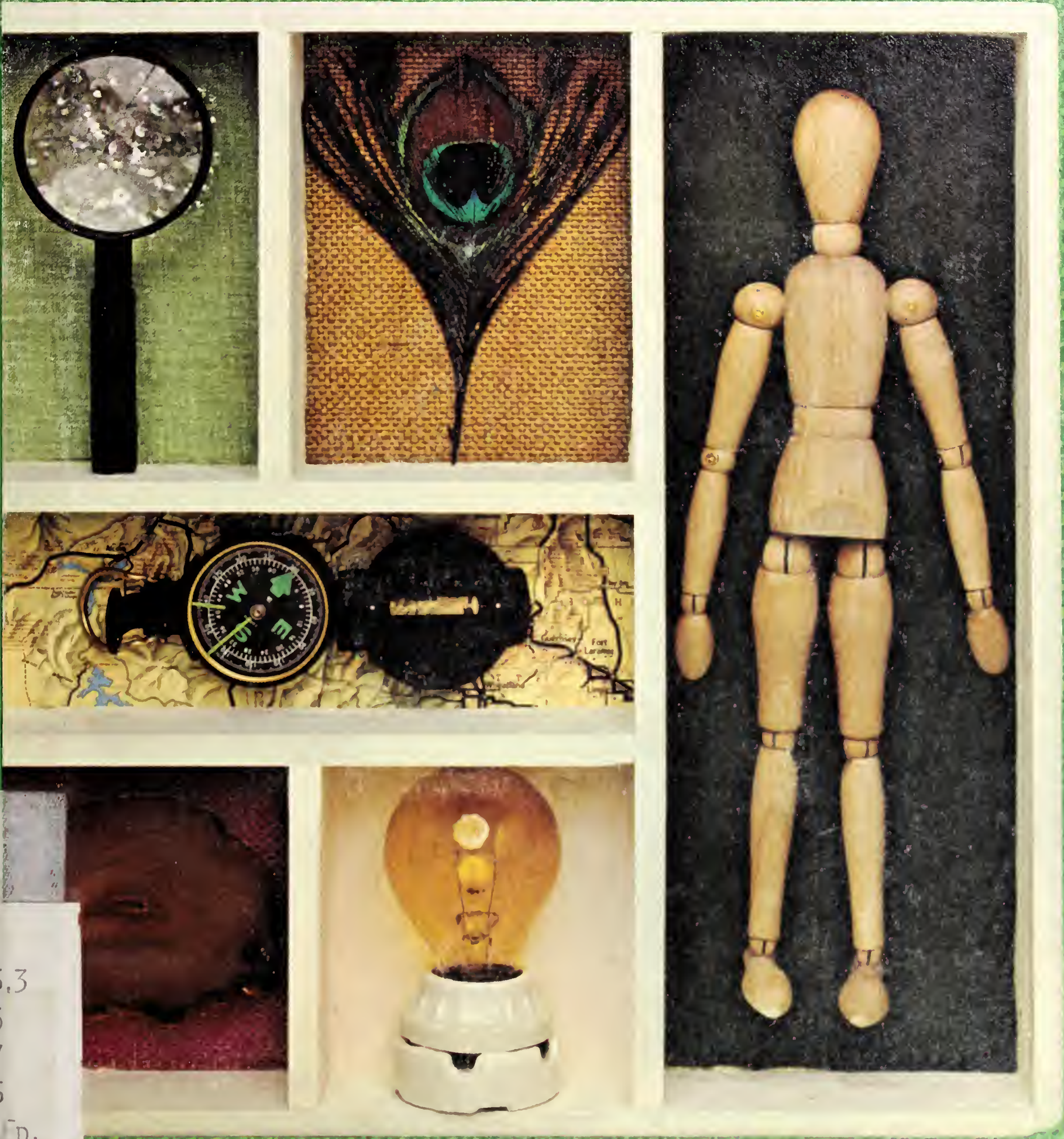

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Exploring Science GREEN BOOK

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(Acknowledgments continued on page 288)

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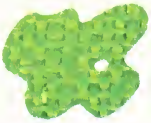

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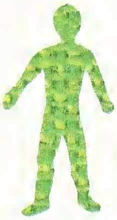

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1 Small Living Things

1. Smaller than a pinpoint
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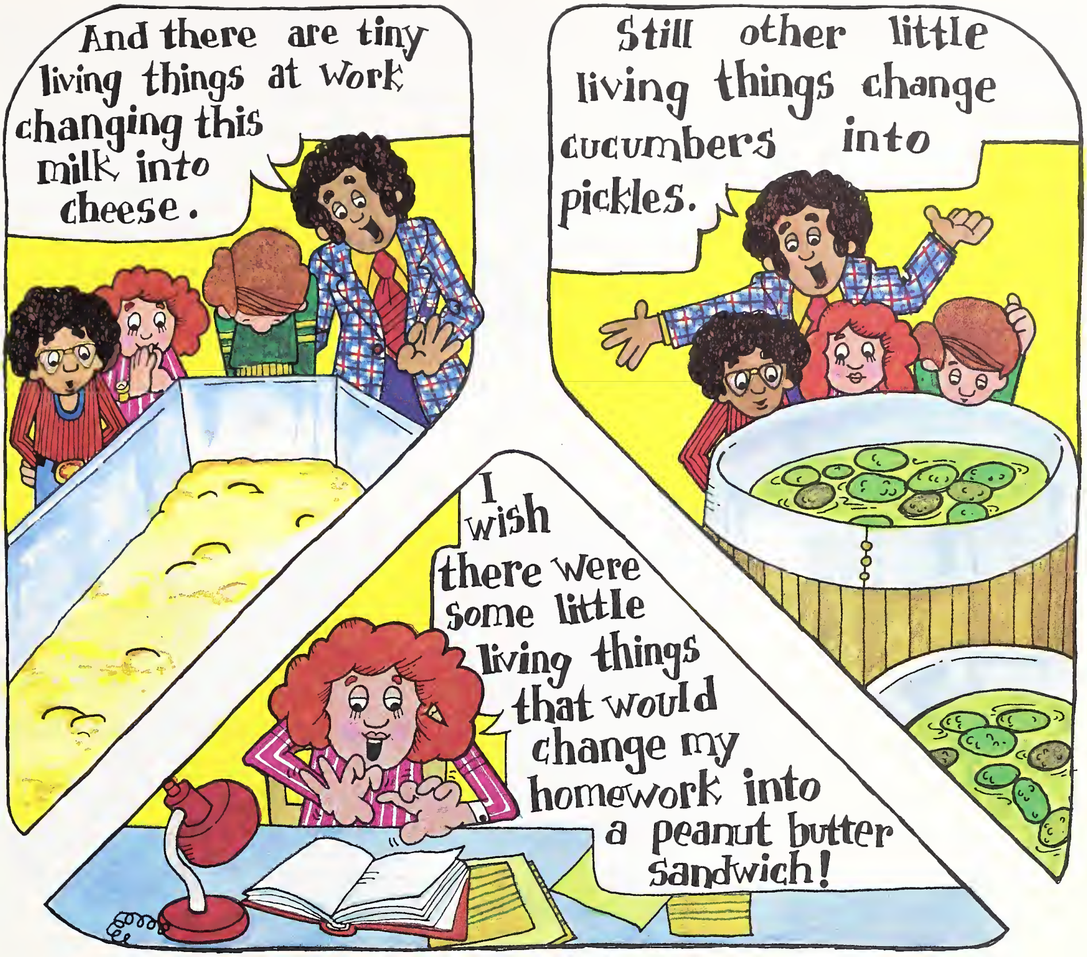
Preparing for the unit: For a list of instructional materials helpful in teaching this unit, see pages T12–T13 of the Teacher's Manual. You may also wish to check the list of materials needed for each "Finding Out" activity in this unit and have the pupils begin collecting these materials. These activities are found on pages 11, 13, 18, 25, 32, 37, and 42.


And there are tiny living things at work changing this milk into cheese.
Still other little living things change cucumbers into pickles.
I wish there were some little living things that would change my homework into a peanut butter sandwich!

How is cheese different from milk?[1]

How are pickles different from cucumbers?[2]

Why can't you see the living things that change milk and cucumbers?[3]

Introducing the unit: You may wish to have the pupils read the cartoon above. Then have the pupils read the questions below the cartoon and discuss their answers to the questions.

Sample answers for questions below the cartoon:

[1] Cheese is thicker than milk.

[2] Pickles taste different from cucumbers.

[3] Those living things are too small.

1 Smaller than a pinpoint

Sometimes you may wonder what it would be like if you were "grown up." But have you ever thought about how it might be if you "grew down"? Suppose you grew so far down that you could fit on the point of a pin. How would things seem to you?[1] What things would you notice most?[2]

It is hard to picture a world as small as a pinpoint. However, such a world can be filled with living things. These living things may affect your life even though you cannot see them.

[1] **Sample answer:** Other things would seem big.

[2] **Sample answer:** I would probably notice most the things that are just as small as I am.

Bacteria

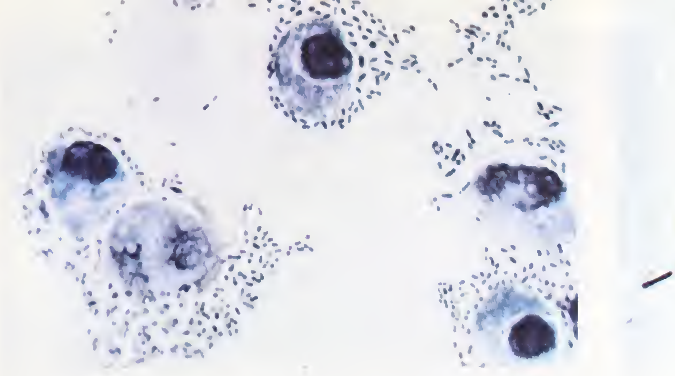
Maybe you ate some chocolate today. Or perhaps you had some cheese or a pickle. If you ate any of these things, you enjoyed the flavours made by tiny living things known as *bacteria* [bak-TIHR-ee-uh].

Main concepts of the chapter (pages 8–22):
Bacteria are tiny one-celled living things.
Protozoans are tiny one-celled animals.
Algae are water plants that can make their own food.
Bacteria, protozoans, and algae are important in many ways.

Performance objectives: After studying the information provided in this chapter, the pupils should be able to

- —list some examples of microscopic living things and state where they can be found;
- —state at least three ways in which bacteria are important to people;
- —list two ways in which protozoans are important;
- —explain two ways in which algae are important.

Important words: bacteria, microscope, colony, cell, reproduce, antiseptic, food chain, decay, protozoans, parameciums, amoebas, euglenas, chlorophyll, algae.



The tiny bodies around the white blood cells pictured on the left are bacteria which cause pneumonia.

What are bacteria like? Although bacteria are living things, they are not usually thought of as being plants or animals. This is because their body is much simpler than the body of plants or animals.

Bacteria are so tiny that more than 1000 of them could fit on a pinpoint! Suppose you were in an airplane flying very high above a countryside. You might not be able to see a house on the ground unless you had field glasses. But you could see a whole village without field glasses. That's the way it is with bacteria. Unless you have a very good *microscope* [MY-kruh-SKOHP], you cannot see just one of these bacteria. But sometimes bacteria grow together in a group. This group is often called a *colony* [KOL-uh-nee]. Sometimes you can see a colony of bacteria without a microscope.

The pictures on this page show what bacteria look like through a microscope. Bacteria are made up of just one *cell* each. A cell is a tiny unit of living matter. Most living things are made up of many cells. What shapes do the bacteria cells have?[1]

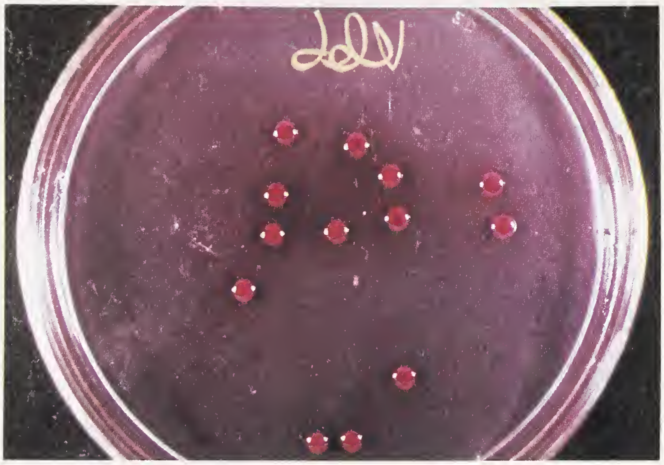
[1] **Sample answer:** They are shaped like beads, spaghetti, or macaroni, only much smaller.

Exploring on Your Own

Many people like to eat chocolate. You may want to know how bacteria make chocolate taste so good. Looking in reference books under the heading *chocolate* may help you find out. Try finding out which other foods get their taste from bacteria.

Suggested discussion and activity: After discussing the last paragraph on page 8, you may wish to have the pupils try the following activity related to how bacteria give some foods their flavour. Have the pupils make sauerkraut. They should shred a small cabbage. Then have them fill an earthenware container with water, adding salt until the water can dissolve no more salt. They should then add the shredded cabbage. The pupils should taste a little piece of the cabbage before and after allowing it to stand in the brine for two or three weeks. Discuss with the pupils what they think caused the flavor change.

Sample findings for "Exploring on Your Own": Certain beans known as cacao beans are placed in piles and covered with banana leaves so that they ferment. In this process the bacteria cause changes, giving the beans the characteristic chocolate taste. Bacteria also cause flavour changes in olives and butter.



Like all living things, bacteria grow and *reproduce* [REE-pruh-D(Y)OOS]. When they reproduce, each cell divides into two cells. The picture above shows bacteria colonies which began from single cells. These bacteria divide every fifteen minutes. The colonies have been growing for twenty-four hours. What do you think the colonies would look like after forty-eight hours? [1]

Where can bacteria be found? Bacteria can live almost anywhere. Some kinds of bacteria are found in cold ocean waters. Other kinds are found in very hot places. Many bacteria can even be found in the air around you!

Most often bacteria live wherever they can find the food they need. They feed on many kinds of things. Some live in fresh milk, fish, or meat. Others prefer garbage or dead leaves. There are even some bacteria in your body. Some of them feed on food that has been taken into your body. How do you think these bacteria get into your body? [2]

[1] **Sample answer:** I think they would be much bigger.

[2] **Sample answer:** Bacteria are on almost everything, so they can get into my body through the air I breathe and the food I eat.

Exploring on Your Own

One very tiny thing that is being studied by many people is the *virus*. Viruses are known to cause many diseases. However, people are not even sure whether or not viruses are living things! See if you can find out more about viruses. You may want to ask a doctor or a school nurse to help you.

Sample findings for "Exploring on Your Own": Viruses are not made of cells and cannot grow or reproduce unless they are in living things.

Teaching helps for the picture above: Bacteria colonies vary in shape and colour. Some have ragged edges; others are smooth edged. Some are translucent; others are opaque. The colony may be almost any colour: white, yellow, orange, or red. These variations are helpful in identifying certain kinds of bacteria.

FINDING OUT

How can you find and grow some bacteria?

You will need: 3 wide-mouthed, metal jar lids; potato; clear plastic food wrap; pan

- Remove any paper lining and rubber from the lids.
- Boil the lids in water for 5 minutes.
- Peel the potato.
  Slice it into pieces 1 cm thick.
- Cook the potato slices for about 5 minutes.
- Using a fork, arrange the potato slices on the lids as shown in the picture.
- Cover 1 lid with plastic wrap right away.
- Leave the potato slices in the other 2 lids uncovered so that bacteria from the air will fall on the potatoes.
- After about 3 hours, cover each lid with wrap. Be sure it does not touch the potato slices.
- Put the 3 lids with potato slices in a warm, dark place.
- Look at the potato slices after 24 hours.

Did you get any bacteria to grow in the first lid? Did you get any bacteria to grow in the other 2 lids? You might want to look at the picture of bacteria colonies on page 10 to help you find out. How do the colonies look after 48 hours? 72 hours?

- When you have finished looking at your bacteria, throw the lids, potatoes, and wrap into the garbage.

Why do you think you should do this?

Teaching helps for "Finding Out":
Processes used: observing, comparing, communicating.
Sample findings: After twenty-four hours, the pupils may notice areas that are slightly raised and discoloured. These areas are the bacteria colonies. The colonies may not necessarily resemble those pictured on page 10. Since there are many kinds of bacteria, there are many variations in the shape and colour of the colonies. The colonies will most likely be larger after forty-eight hours. At seventy-two hours, the colonies may have stopped growing, since the conditions for growth would be increasingly less favourable.
Additional information: The cleanup operation after this experiment should be carefully supervised. The pupils should throw everything away without even removing the wrap because some bacteria are harmful.

Why are bacteria important? When certain bacteria get into your body, they can cause you to become sick. Many sore throats and fevers are caused by bacteria. When sick, you may be given some medicine to kill the bacteria.

You may have fallen and cut yourself at some time. Bacteria might get into such a cut. Then someone might have put an *antiseptic* [ANT-uh-SEHP-tihk] on the cut. This would keep the bacteria from making it sore. Antiseptics are used to kill harmful bacteria. What are some ways in which your body protects itself from harmful bacteria?[1]

Some bacteria are harmful because they spoil food. Some of these bacteria are found in milk. If the bacteria grow too fast, they can turn the milk sour. Keeping milk in the refrigerator keeps the bacteria from growing too fast. Freezing foods is another way of keeping bacteria from spoiling them. What are some other ways to keep bacteria from spoiling food?[2]

[1] **Sample answer:** My skin can help keep bacteria out of my body, and acids in my stomach can kill some harmful bacteria.

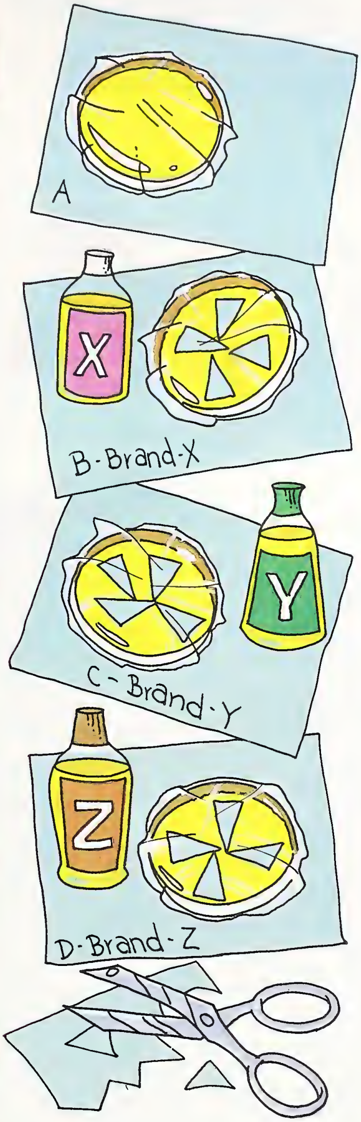
[2] **Sample answer:** Drying out foods, such as certain fruits, helps keep them from spoiling. Pickling and canning foods also keeps them from spoiling.

Exploring on Your Own

People have always tried to keep food from spoiling. You may want to find out how people kept food from spoiling before canning and freezing were discovered. Look in reference books under *food preservation*.

Sample findings for "Exploring on Your Own": Drying foods in the sun, smoking foods, putting them in brine, salting them, or soaking them in vinegar are all ways people have used to keep foods from spoiling.

Suggested research: After discussing in the last paragraph the fact that there are bacteria found in milk, you may wish to have the pupils find out how harmful bacteria are destroyed in milk. For the pupils to do this, have them visit a local dairy to learn how milk is pasteurized or have them look in reference books under *pasteurization*.



FINDING OUT

How can you stop bacteria from growing?

You will need: 4 wide-mouthed, metal jar lids; clear plastic food wrap; 1 package of plain gelatin; 1 bouillon cube; 1 tablespoon of sour milk; 3 brands of antiseptics (mouthwashes will do); small mixing bowl; paper towels

- Remove any paper lining and rubber from the lids.
- Boil the lids in water for 5 minutes.
- Cut the paper towel into 12 narrow triangles.
- Mark the lids A, B, C, and D.
- Stir the gelatin, bouillon, and a cup of boiling water in the mixing bowl. Wait until all is dissolved.
- Pour in 125 ml of cold water. When the mixture has cooled, but not set, stir in the sour milk. The sour milk has bacteria you will need.
- Pour some of the mixture into each of the lids.
- Wait 15 minutes or until the mixture is set. Cover lid A with wrap.
- Dip 4 of the paper triangles into one of the antiseptics. Arrange the triangles in lid B as shown. Mark down which antiseptic is used in lid B. Cover it with wrap.
- Do the same thing with the other 2 lids, except use a different antiseptic in each one.
- Put the lids in a warm, dark place for 3 days.

What happened in the lid that had no antiseptic? What happened in the lids that had antiseptics? Which antiseptic was best in keeping bacteria from growing? How can you tell? Be sure to throw away the lids and everything in them.

Teaching helps for "Finding Out":

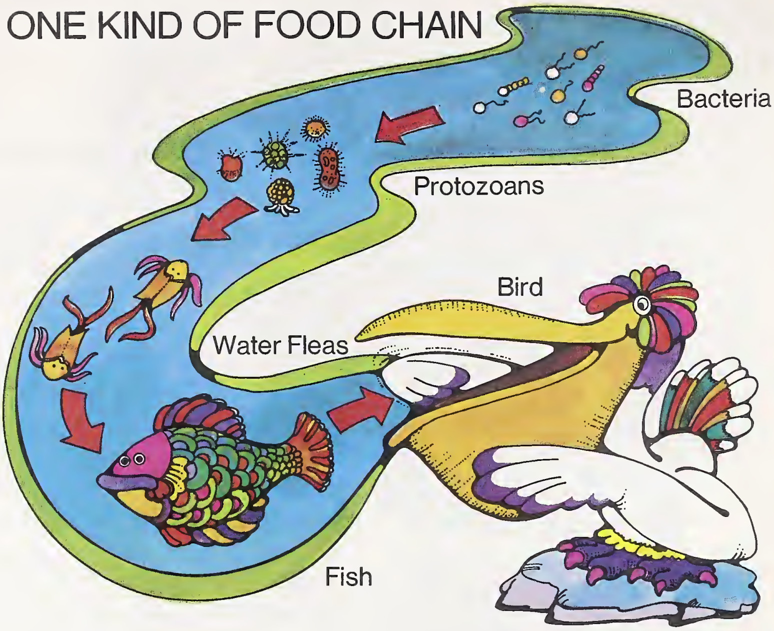
Processes used: observing, comparing, communicating.

Sample findings: The pupils most likely will observe that the lid with no antiseptic had greater bacterial growth than those lids with antiseptics. They will notice an area of inhibition close to the triangles that have been dipped in an antiseptic. The areas of inhibition will vary in size according to the strength of the antiseptic, so that a larger area of inhibition will surround a stronger antiseptic.

Extending the "Finding Out": It may be interesting to have the pupils compare the effectiveness of the various antiseptics. Some antiseptics, like mouthwash, may be less effective than other antiseptics, such as those used only externally.

Additional information: Caution the pupils to use the same care in disposing of the lids as in the previous "Finding Out."

ONE KIND OF FOOD CHAIN



Bacteria can also be helpful in many ways. One way is that they are used as food for tiny animals. Larger animals, in turn, feed on the tiny animals. This makes a kind of chain. It is often called a *food chain.* Suppose there were no bacteria for the tiny animals to feed on. What would happen to the larger animals?[1]

Bacteria are helpful in other ways. When some bacteria feed on things, they cause them to *decay,* or rot. These bacteria cause dead animals and plants to decay. As dead animals and plants decay, they become part of the soil. This makes the soil rich for plants to grow in. Bacteria in your intestines help break down the food you eat. Why do you think this food must be broken down?[2]

[1] **Sample answer:** Since the tiny animals would probably die, the larger animals would probably die, too.

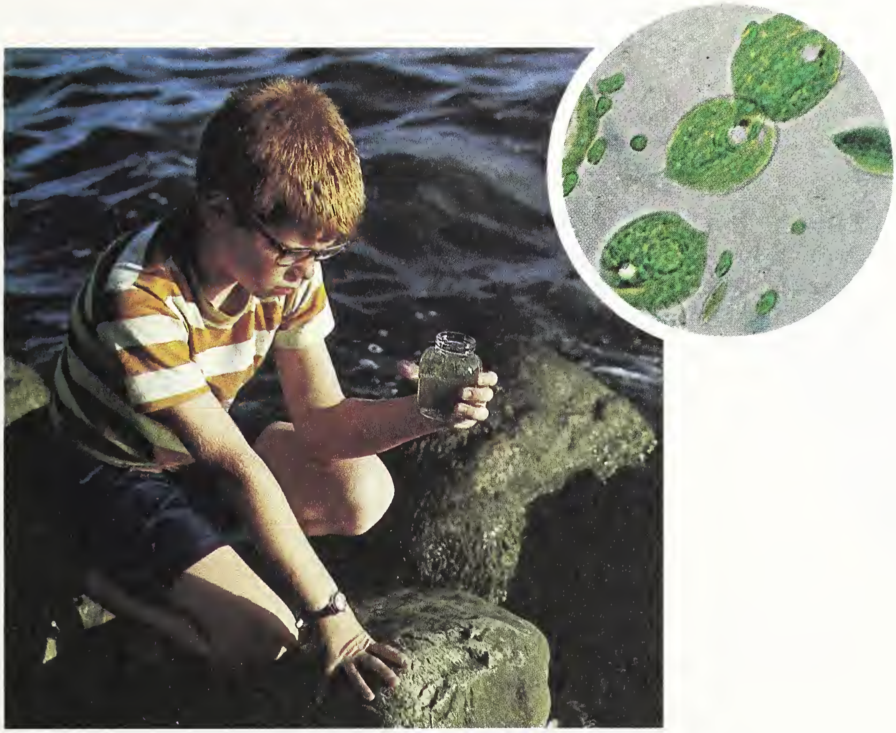
[2] **Sample answer:** To make it easier to digest.

Teaching helps for the picture above: The food-chain concept is greatly simplified in the picture for the sake of clarity. Each plant and animal is most likely a part of several food chains forming a food web. The important thing is for the pupils to understand the dependency of some animals, such as the bird, on other animals for food in a chainlike fashion.

Protozoans

Have you ever collected water from a pond? If so, you may have noticed many living things in it. If you looked closely enough, you may have seen very tiny dots moving about. These very tiny dots were probably living things called *protozoans* [PROHT-uh-ZOH-uhnz]. Their name means "first animals."

What are protozoans like? Look at the picture of the protozoans on this page. You may not think they look like animals. Some people say they are like animals because they can move about. And like animals, they must eat in order to live. But while other animals are made up of many cells, protozoans, like bacteria, are made up of just one cell.

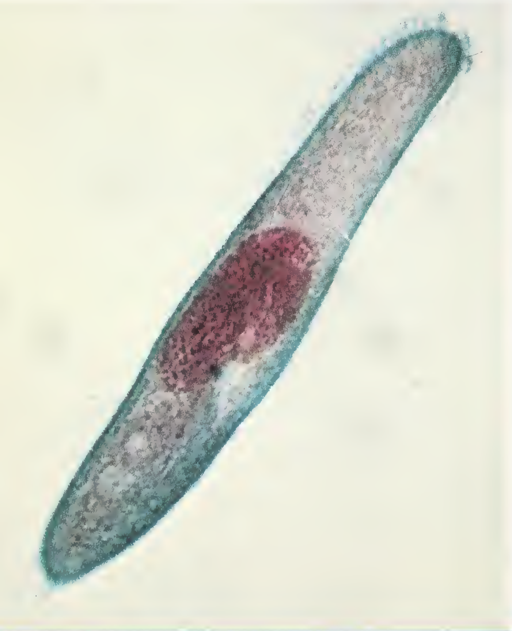


Suggested activity: After discussing the first paragraph under "Protozoans," you may wish to involve the pupils in an activity that would help make them aware of the presence of protozoans in many places. Have the pupils collect water from various sources: a standing rain puddle outside school, a pond in the park, and water from a vase in which flowers have been standing. Have the pupils watch for signs of life in the jars of collected water. If you have access to a hand lens or microscope, this may be helpful in viewing the protozoans.

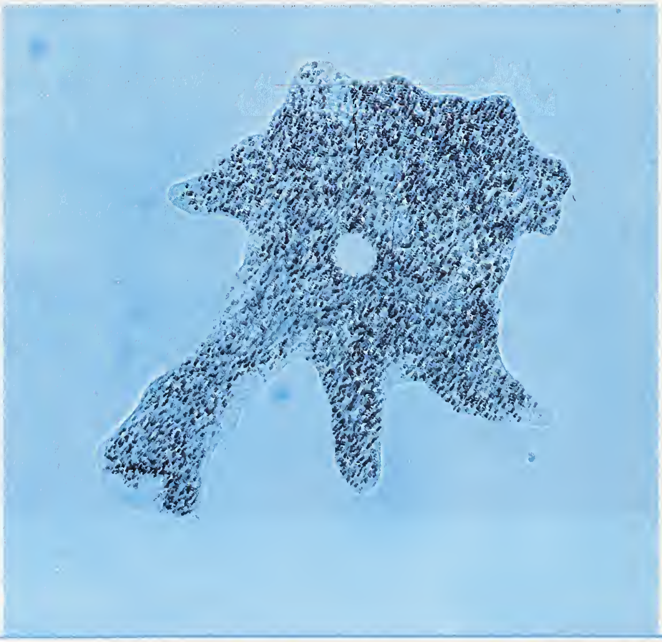
Protozoans are too small to be seen well without a microscope. But if you looked at them through a microscope, you would notice many things about them. One kind of protozoan is shaped like the sole of a shoe. It is called a *paramecium* [PAR-uh-MEE-sh(ee-)uhm]. Parameciums are covered with tiny hairs which act like oars to move them about. Parameciums must eat things smaller than themselves, such as bacteria and smaller protozoans. They have a "mouth" with hairs around it to sweep the food in. They even have a tube to carry the food from the mouth to the inside of the cell.

Another kind of protozoan, the *amoeba* [uh-MEE-buh], doesn't have any special shape. An amoeba is like a drop of jelly. Amoebas push out "feet" from any part of the cell to help them move. Amoebas also eat with their "feet." When food is near, they close their "feet" around it until the food is inside them.

Paramecium



Amoeba



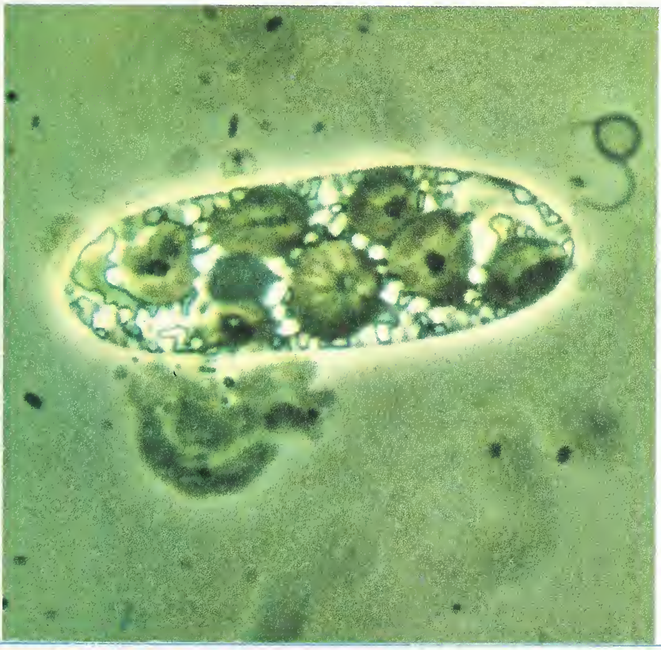
Teaching helps for the pictures above: The structural differences among the various types of protozoans are mentioned in the text so that the pupils will be aware of the wide variety of structures among protozoans. Such differences are interesting for discussion, but no attempt should be made to encourage memorization of such facts by the pupils. Only the broad differences should be noted: the presence of tiny hairs for locomotion (paramecium), the presence of a whip for locomotion (euglena), and the use of pseudopodia, or "false feet" (amoeba). You may wish to ask the pupils this question: Which method of locomotion do you think would be fastest? (Sample answer: The whip, because it's long and could move fastest.)

Another protozoan is the *euglena* [yu-GLEE-nuh]. Euglenas have a long whip that moves them through the water. How might the whip help them do this? [1]

When it comes to eating, euglenas have it best of all. If the sun is shining, they can make their own food. They have something green called *chlorophyll* [KLOHR-uh-FIHL] in their cell. Chlorophyll, with the aid of sunlight, helps them make their own food as many plants do. They even have an "eye" which helps them find the sunlight. When the sun is not shining, they can eat as other protozoans do. Why do you think it is helpful to the euglena to be like both a plant and an animal? [2]

Like bacteria, protozoans can reproduce by dividing into two cells. Suppose you had one protozoan. And suppose it reproduced once every day. If you wanted to give a protozoan to each of eight friends, how many days would they have to wait? [3]

Euglena



The protozoans on these two pages have been greatly magnified. How is this helpful in studying them?

---

[1] **Sample answer:** As the whip moves, it pushes against the water and gives the euglena a push forward.

[2] **Sample answer:** Because it would seldom go hungry.

[3] **Sample answer:** Three days. (At the end of the first day, there would be two. At the end of the second day, four. At the end of the third day, eight.)

Sample answer for the caption: They are easier to see when they are magnified.

FINDING OUT

How can you raise protozoans?

You will need: jar of rainwater or distilled water, dried grass or weeds, hand lens, eyedropper

- Place the dried grass or weeds into the jar of rainwater. Let the jar stand for 3 or 4 days.
- Hold the jar up to the sunlight.

Do you see any signs of life in the jar? If so, what are the living things doing?

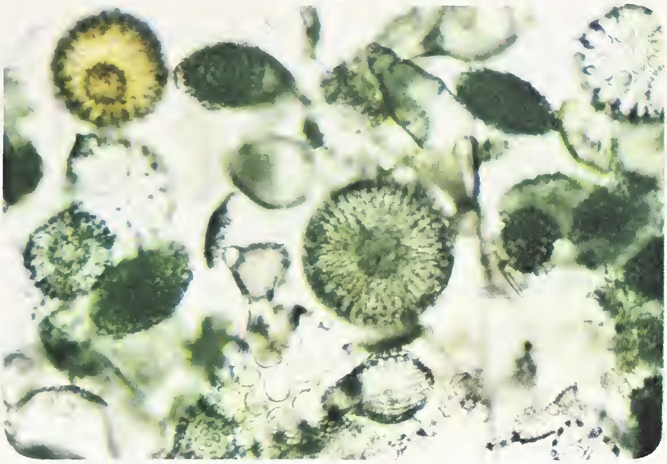
- Using the eyedropper, put some of the water with moving things into a glass dish. Look at it with the hand lens.

Do you think there are any protozoans there? What makes you think so?

Where can protozoans be found? Protozoans live in many places. Ponds and damp soil will very likely have many protozoans. Many protozoans live in oceans. Some might even live in your body.

One kind of protozoan lives in the stomach of a small insect. The insect is called a *termite* [TUR-MYT]. Termites look something like ants. During their early stages they eat wood. They eat tunnels in the wood. This helps break down old, dead trees. The protozoans in

Teaching helps for "Finding Out":
Processes used: observing, inferring, communicating.
Sample findings: The pupils will most likely notice very tiny dots moving in the water. Under a hand lens the movement should be more obvious. Have the children take samples from different levels in the jar and observe them under the hand lens. Different kinds of protozoans have a preference for different surroundings.



The protozoans shown here are found in the ocean. They have a hard outer covering. How do you think this covering is helpful to them?

the stomach of the termites digest the wood for them. When might the work of termites be harmful to people?[1]

Why are protozoans important? Most kinds of protozoans are harmless to people. But some kinds of protozoans cause people to become sick. Maybe you have heard of the sickness called *malaria* [muh-LEHR-ee-uh]. A kind of protozoan causes this sickness. The protozoans which cause malaria are often found inside a certain kind of mosquito. When the mosquito bites someone, the protozoans may get into the blood of that person. This will cause that person to become sick with chills and fever. In what way do you think malaria could be stopped?[2]

Some kinds of protozoans are helpful to living things. Protozoans are the main food of many small animals in the ocean. Even some kinds of whales have protozoans for part of their meals! Do you think protozoans are important in food chains in ponds and streams? Why or why not?[3]

[1] **Sample answer:** When the termites eat the wood in people's houses or in things people use.

[2] **Sample answers:** I think people could take medicine that would kill the protozoans that cause malaria. I think people could kill the mosquitoes that carry the protozoans that cause malaria.

[3] **Sample answers:** Yes. Because small animals in ponds and streams need them for food.

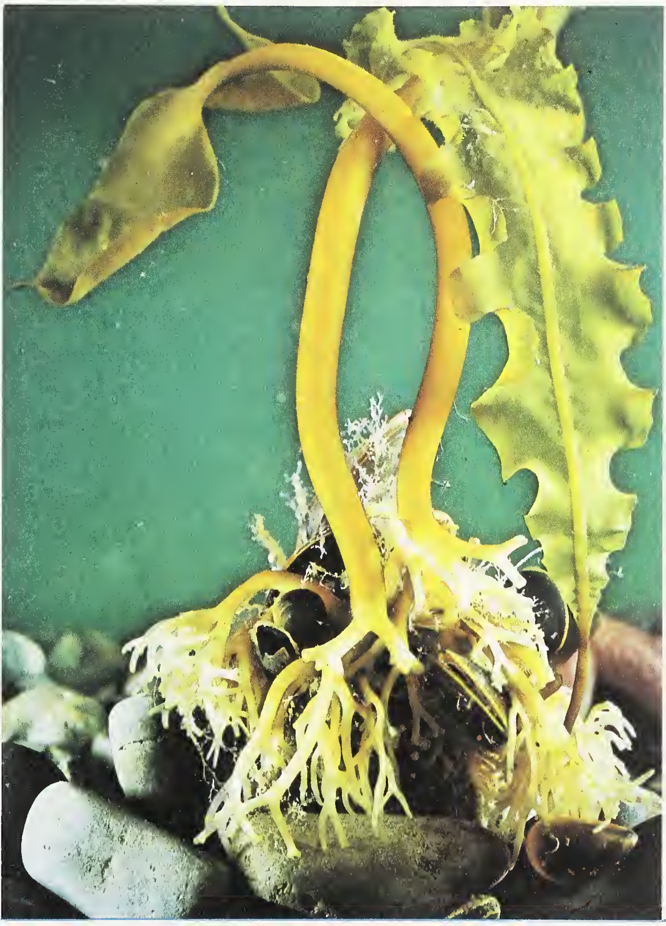
Suggested discussion: After discussing "Why are protozoans important?" it may be interesting for pupils to find out which kinds of whales eat protozoans as a part of the plankton they take in. Some of the largest whales, baleen whales, belong to the group that eat plankton. Plankton consists of many kinds of living things in the ocean besides protozoans—crustaceans, jellyfish, and many kinds of algae. Baleen whales are especially equipped to eat plankton. These whales have horny plates in their mouth that help strain their food from the water. These plates are called baleen. A fringe of bristles attached to the plates helps in the straining. A large whale probably eats from 450 kg to 1360 kg of plankton each day. The pupils may wish to look in reference books under *whales*.

Sample answer for the caption: As a protection for these tiny protozoans.

Algae

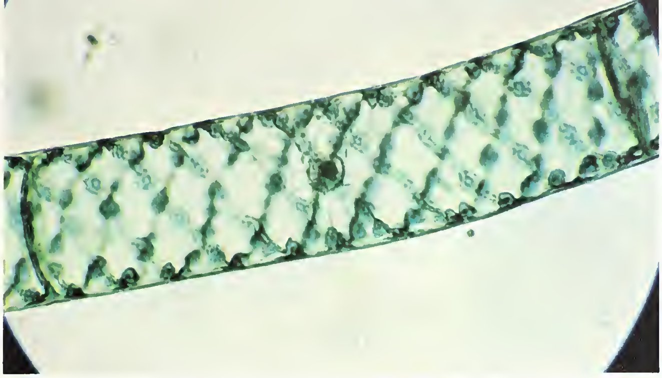
When was the last time you had ice cream? Maybe you noticed how thick it was. Ice cream is thick because it has something in it which comes from plants called *brown algae* [AL-jee]. Besides brown algae there are other kinds of algae.

What are algae like? Many kinds of algae are small enough to fit on a pinpoint. But others would not even fit into your classroom. They are over 30 m long!



This kind of brown algae, known as kelp, lives in the ocean. How is kelp like other plants you know of? How is it different?

Sample answers for the caption: It is like other plants because it has leaves. It is different from other plants because its leaves are not green.
Suggested discussion: After discussing the first paragraph under "Algae," you may wish to bring out that the material from brown algae that makes ice cream thick is called algin. Algin contains a gummy substance that makes it useful in thickening many things, such as cosmetics, pills, and mayonnaise.



This kind of green algae is found in ponds and streams. Where in the cell of these algae is the chlorophyll located?

Some kinds of algae live as a single cell. Each cell does all the work that a living thing must do. Breathing and taking in food are examples of such work. Other kinds of algae form chains of cells. Still others live in a colony. Why would it be helpful for algae to live in a colony? [1]

All algae have chlorophyll. So they can make their own food. But not all algae are green. Some are red, some are brown, and others are golden brown. These colours they have block out the green chlorophyll.

Where can algae be found? Maybe you have seen green scum in fishbowls or on rocks in ponds and streams. This scum is really algae. Algae can also be found in the ocean. In fact, one reason the ocean often looks green is because of its many algae, especially near the shore. What other bodies of water might look green because of algae? [2]

Why are algae important? You probably know how important green plants are to you. Even if you ate nothing but meat, you would soon starve if all the green

[1] **Sample answer:** Living in a colony is often helpful to the algae for protecting themselves.

[2] **Sample answer:** Lakes, rivers.

Suggested activity: After discussing "Where can algae be found?" the pupils may wish to look for algae in a pond. They might also look for algae on the trunks of some trees. If a hand lens or a microscope is available, the pupils may wish to observe algae under magnification.

Sample answer for the caption: It is located in the parts of the cell that are green.

In many parts of the world, algae, such as those shown, are dried out and ground into flour. What food might you make from this flour?

plants were to die. This is because the animals used for meat must eat green plants to live. Or they eat things made from green plants. What animals and green plants do you know of that might be part of such a food chain?[1]

Algae are also an important part of food chains. Protozoans and other animals eat the algae. Bigger animals then eat these animals. Why do you think some people say algae are the most important link in the food chains in bodies of water?[2]

Besides serving as food for animals, algae are important in another way. As the algae make food, they give off *oxygen* [OK-sih-juhn] into the air and water. Why do you think this is important?[3]

A Second Look

1. How are bacteria helpful to you?
2. How can you keep bacteria from spoiling food?
3. What are protozoans?
4. Why are algae important in some food chains?

[1] **Sample answer:** Horses eat grass or feed made from green plants.

[2] **Sample answer:** Because algae form the beginning of most food chains in bodies of water.

[3] **Sample answer:** Because living things need a constant supply of oxygen.

Sample answer for the caption: Pancakes or cakes. **Sample answers for "A Second Look":** 1. Bacteria give some foods their flavour. Bacteria help break down the food in my intestines. Bacteria are a part of some food chains. 2. I can keep bacteria from spoiling food by keeping the food in the refrigerator, especially in the freezer. 3. Protozoans are small one-celled animals. 4. Algae are important in food chains in the water because they are the beginning of these food chains.

2 Matchbox garden

What do you like most about gardens? The shapes and colours of the flowers? The different kinds of leaves you see? Most of the plants you see in gardens have these parts. But there are some plants that do not. Most of these plants are small. Some are small enough to grow in a matchbox!

Fungi

Maybe you have seen a mushroom "pop up" overnight. Its umbrella-shaped cap is easy to see. A mushroom is one of the plants called *fungi* [FUHN-JY].

Main concepts of the chapter (pages 23–28):

Fungi are small plants that cannot make their own food.

Mosses are small green plants that do not have tubes in their roots, stems, and leaves, as many bigger green plants do.

Fungi and mosses are important to people in many ways.

Performance objectives: After studying the information provided in this chapter, the children should be able to

- —identify two kinds of fungi;
- —state the main differences between mosses and many of the bigger green plants;
- —state three ways that fungi and mosses are important to people.

Important words: fungi, yeasts, spores, mold, athlete's foot, mosses.

Oyster Mushrooms

What are fungi like? Mushrooms and other fungi are unusual plants. They are not green, because they have no chlorophyll. So they cannot make their own food.

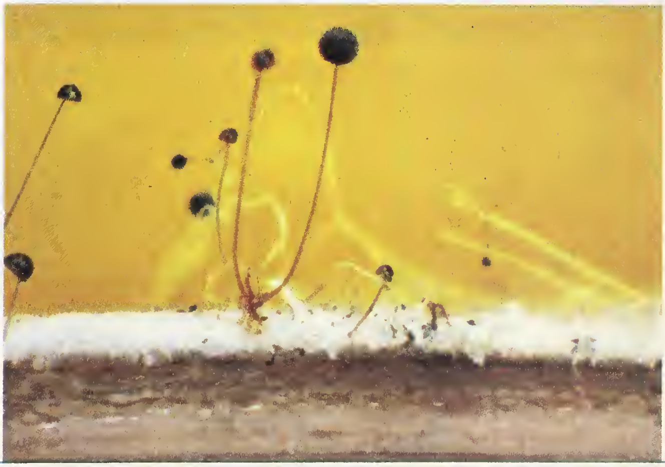
Fungi called *yeasts* [YEESTS] are made of just one cell. Other fungi called molds have a body made up of threadlike parts. In mushrooms these threadlike parts are woven together.

Most fungi reproduce by means of *spores* [SPOH(UH)RZ]. Spores are tiny cells from which new fungi grow. Spores are made in a special spore-forming part of fungi. You may have noticed black dots forming on bread mold. Those are the spore-forming parts of the bread mold.

The cap of the mushroom has a part which may make millions of spores. It is the underside of the cap that does this. Each spore that falls on damp soil or rotting wood may grow into a new mushroom. Or, the spores may be carried away from the mushroom. How do you think the spores might be carried away?[1]

Yeasts often reproduce in another way. Little buds form on a yeast cell. Soon, they pinch off and become new yeast cells.

Bread Mold (about 30 times its size)



[1] **Sample answer:** They might be carried away by the wind.

Suggested activity and research: After discussing "What are fungi like?" the pupils may wish to collect and observe mushrooms and various other fungi. They may wish to find out more about the plants they collect by looking in reference books under *fungi*.

FINDING OUT

How can you grow bread mold?

You will need: 3 jars with screw tops, 2 paper towels, piece of bread

- Cut the bread into 3 pieces.
- Leave them uncovered for about 2 hours.
- Put 1 piece of bread in the first jar. Close the jar. Put it in a warm, dark place.
- Moisten the 2 paper towels. Fold the paper towels.
- Put 1 in each of the other jars.
- Put 1 piece of bread on top of each of the towels.
- Screw the tops on. Put 1 jar in a warm, dark place.
- Put the other jar in the sunlight. Wait for 3 or 4 days.

Do you see any fuzzy mold growing on any of the pieces of bread? (If not, wait a day or so longer.) Which jar has the best mold growth? Why? Try growing molds on other things and under other conditions.

Where can fungi be found? Have you ever walked into a basement and noticed a musty smell? This smell may have been caused by fungi. Many basements are damp and dark. This is the kind of place in which fungi grow best. Baseball gloves, shoes, and old clothes left in damp basements often have fungi growing on them. Since fungi cannot make their own food, they must grow on plants or animals. Or they must grow on things made from plants and animals. What might you do to keep fungi from growing on things?[1]

[1] **Sample answer:** I would keep them very dry and cover them so that spores wouldn't get on them.

Teaching helps for "Finding Out":
Processes used: observing, communicating, inferring.
Sample findings: The pupils most likely will find the best mold growth in the jar with a moist towel placed in a warm, dark place because this provides the conditions that molds require.

Extending the "Finding Out": The pupils might try growing molds on week-old pudding or damaged fruit. They may try growing molds at different temperatures. They may also try growing molds on such things as plastic, metal, wood, and different kinds of cloth.

Why are fungi important? If you had a sandwich today, fungi helped you. Yeast made the bread in your sandwich rise before and during baking. This makes bread light, soft, and good to eat. Other kinds of fungi are also important as foods. Mushrooms are enjoyed by many people. Some cheeses taste better because of molds growing inside them.

Fungi are helpful in other ways. Molds help break up dead plants and animals. The soil is made richer in this way for growing green plants. Some medicines are made from molds.

Exploring on Your Own

Try to find out how yeast makes bread rise. Ask someone who works in a bakery. Or look in reference books under *yeast* or *bread making.*

Sample findings for "Exploring on Your Own": Substances made by the yeast cells change the starch in the flour into sugar. The sugar is then changed to alcohol and carbon dioxide gas. The gas bubbles through the dough, making it light and full of holes. When the bread is baked, the alcohol evaporates.

Suggested activity: After discussing "Why are fungi important?" the pupils may wish to visit a neighbourhood bakery to watch the process of bread making.

Suggested research: After discussing the last paragraph on this page, the pupils may be interested in how some medicines are made from molds. Have them look in reference books under *antibiotics* or *penicillin.*

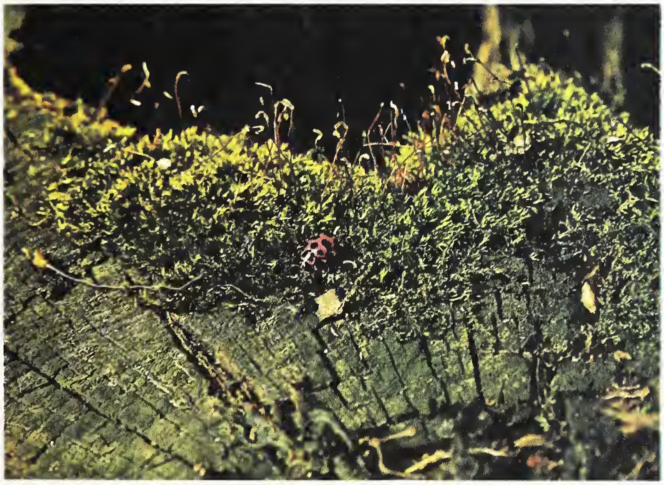
Although fungi can be helpful, they can also be harmful. Some fungi cause plants, animals, and people to become sick. The fungi may grow on or in them, causing damage. Athlete's foot is a problem caused by fungi. How can you keep from getting athlete's foot? 1

[1] **Sample answer:** By keeping my feet dry, by being careful where I shower, and by being careful to wash my feet after walking barefoot.

Mosses

Have you ever noticed tiny green plants growing in the shade near buildings or on trees? If so, you may have been looking at small plants called *mosses.*

What are mosses like? If you ever pulled mosses from the ground, you know they have roots that are not like those of other plants. Little hairs at the base of the stem hold the plant upright. These hairs take in water and minerals.



At certain times of the year, mosses have tiny, upright parts growing from them. These are the spore-forming parts. Find these parts in this picture.

Suggested activity: After discussing "What are mosses like?" pupils may wish to take a walk in a park or some shaded area to see mosses growing. They may wish to observe the parts mentioned in the text. Depending on the time of the year, they may be able to see the entire life cycle of some mosses.

Mosses do not have stems or leaves that are like those of other plants, either. The tubes found in the roots, stems, and leaves of bigger green plants are missing in mosses. These tubes carry water, minerals, and food through the bigger plants. In mosses, these things pass from cell to cell.

Where are mosses found? You could look for mosses in almost any cool, wet, shady place. They can be found in the woods. They can be found on the banks of streams and ponds. Even if a stream or pond dries up, mosses can live through long, dry spells. They start growing again when water returns.

Why are mosses important? People at flower shops often pack flowerpots with mosses. They do this because mosses hold water for a long time. Gardeners also mix mosses with their soil. They make the soil good for plants to grow in. Some mosses are dried and burned as fuel.

Mosses are also good soil builders. Their rootlike parts grow into the cracks of rocks. This helps break up the rocks to form soil. What other ways do you know of that plants help form soil? [1]

Exploring on Your Own

Mosses have a very interesting life cycle. You may want to find out something about their life cycle. Look in reference books under *mosses*.

[1] **Sample answer:** When plants die and decay, they help form soil.

A Second Look

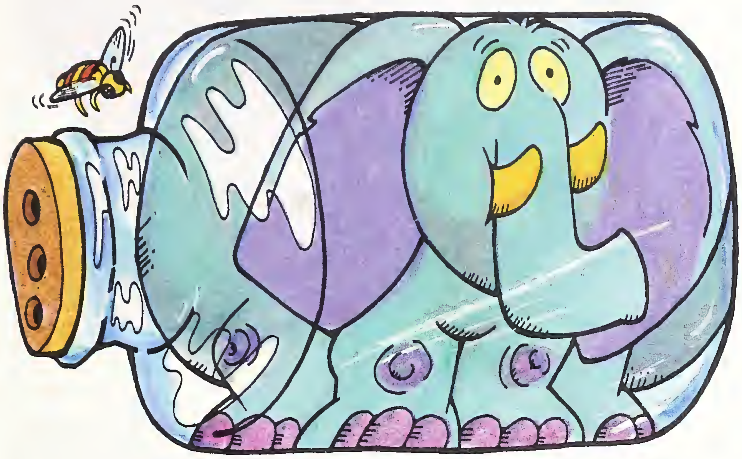
1. Why can't fungi make their own food?
2. Where do molds grow best?
3. How are the roots, stems, and leaves of mosses different from those of other green plants?

Sample findings for "Exploring on Your Own": The life cycle of a moss plant begins with a spore. A spore cell falls on the ground and develops into the green leafy plant most people are familiar with. Male and female sex organs grow out of the leafy shoot. The female organs produce egg cells, and the male organs produce sperm cells. When there is moisture on the plants, the sperm cells swim to the egg cells and fertilize them. From the fertilized egg, a new kind of plant grows, which stays attached to the old plant. The new plant grows long stalks. At the top of the stalks spores are formed, ready to begin the process again.

Sample answers for "A Second Look": 1. Fungi can't make their own food because they don't have chlorophyll. 2. Molds grow best in warm, dark, moist places, such as basements and some closets. 3. The roots, stems, and leaves of mosses do not have tubes to carry things through the plant.

3 Minizoo

Suppose you had a jar and wanted to put some animals in it to watch. Which animals would you choose for your jar?



Worms

Have you ever gone fishing? If so, you may have used worms to catch the fish. How about worms for your minizoo?

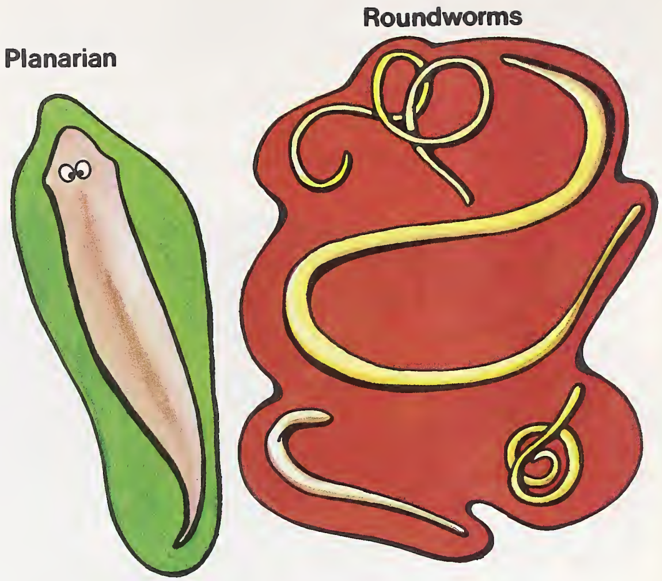
What are worms like? You may think of worms as animals that crawl about in the soil. There are worms that live in water, too. One such worm is the *planarian* [pluh-NAR-ee-uhn]. Planarians are flatworms that live in water. Although they live in water, planarians don't swim. They glide along the surface of things. If there is nothing to glide along, they send out some sticky threads and weave their own "magic carpet."

Main concepts of the chapter (pages 29–43):
There are many kinds of worms.
Although insects can be harmful to other living things, they can also be helpful.
Many spiders are helpful to people because they eat insects that destroy crops.

Performance objectives: After studying the information provided in this chapter, the pupils should be able to

—classify worms as either flatworms, roundworms, or worms with rings;
—state three ways that worms, insects, and spiders each are important to other living things.

Important words: flatworms, roundworms, earthworms, sandworms, planarians, tapeworms, hookworms, insects, queen, drones, workers, spiders, pollen, spinnerets, tarantulas, black widows.



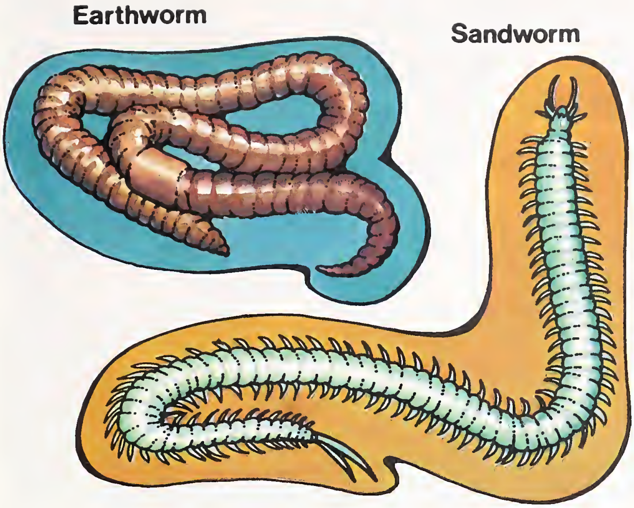
The planarian in this picture is about twenty-five times larger than a real planarian. The roundworms are shown about actual size.

Besides living in water, there is another way that planarians are different from most other worms. Most worms have a mouth at the front end. A planarian's mouth is in the middle of its body. It has a long tube, like an elephant's trunk, which comes out through its mouth. A planarian uses this tube to take in food.

Have you ever seen some tiny worms in an old, old bottle of vinegar? These are called vinegar eels. They are roundworms. Like most roundworms, their body is shaped like a smooth tube. It is rounded in the front and pointed in the back.

The worms you probably know best are earthworms. Earthworms are shaped like a tube, just as roundworms are. But earthworms differ from roundworms. Earthworms have rings around their body. The rings mark the many parts into which an earthworm's body is

Suggested research: After discussing "What are worms like?" on pages 29–31, the pupils may wish to find out more about planarians. Many experiments with planarians demonstrate their remarkable ability for regeneration. That is, when planarians are cut into pieces, a new planarian will grow from each piece. Pupils may find out about this by looking in reference books under *planarians* or *regeneration.*



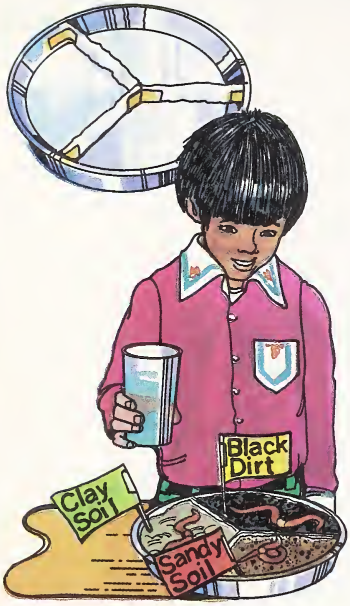
Earthworms and sandworms come in many sizes. The ones shown here are about average size.

divided. The earthworm's body also has many tiny bristles. You can often feel these bristles on the underside of an earthworm. How do you think these bristles are helpful to an earthworm?[1]

Another worm with rings around its body is the sandworm. People who fish in seawater can tell you about the nasty bite of a sandworm. Sandworms most often hide by day in the sand. At night they swim in the water or crawl along the sand.

Where can worms be found? Some flatworms live in lakes, ponds, and streams. Other flatworms live in the body of animals or people. Roundworms live almost everywhere: in the soil, in the water, and inside plants and animals. Some worms with rings live in the soil. Other worms with rings live at the bottom of the sea or along the seashore. Where have you seen worms?

[1] **Sample answer:** They help the earthworm to hold itself in the ground when birds or other animals try to pull it out of the ground.



FINDING OUT

What kind of soil environment do earthworms like?

You will need: 3 earthworms, different kinds of soil (clay, sandy soil, black dirt), pan, water, heavy tinfoil

- Divide the pan into 3 equal parts, using the tinfoil as shown.
- Put a different kind of soil in each part. Make a sign for each part as pictured.
- Sprinkle the same amount of water on each part. Sprinkle just enough water to moisten the soil.
- Place an earthworm in each part. Wait a day.

What did the earthworms do?
Which soil environment do the earthworms like best?
Why do you think this is so?

Why are worms important? Some kinds of worms can be harmful to people. Sometimes pigs have flatworms called tapeworms in their body. They might also have roundworms. Suppose the meat from these animals is eaten without being cooked enough. Then the worms stay alive. The tapeworms might then stay in the intestines of the person eating the meat. The tapeworms would use up some of the food the person eats. The roundworms may get into the person's muscles. This could be painful.

Teaching helps for "Finding Out":
Processes used: observing, inferring, communicating.
Sample findings: The pupils will most likely find that the earthworms placed in the clay and sandy soil move away from where they were placed. The earthworms will most likely show a preference for the black dirt because it holds the moisture and air better and is often richer in minerals.
Suggested activity: After discussing "Why are worms important?" pupils may become concerned about the fact that beef can be eaten rare, while pork must be cooked thoroughly. They may wish to ask a butcher why this is so.

A meat inspector checks meat for tapeworms and roundworms. Why do you think this is important?

Other roundworms, called hookworms, get inside people in another way. They enter the body through the skin. Some people who walk barefoot on the soil may be troubled with hookworms. Hookworms live on the blood of a person. This might make the person weak and ill. Why? 1

Some roundworms are harmful to plants. They get into the stems and roots of some plants. The plant may grow little knobs around the worms. In what ways might the roundworms be harmful to these plants? 2

Worms, however, can also be helpful to animals and plants. Birds eat earthworms. And so do toads. Earthworms help bring air to plants as they tunnel through the soil. Earthworms help plants in another way. They take in soil with the food they eat. When the soil is later cast out of the worms' body, the soil is richer in minerals. Why do you think this is important for plants? 3

[1] **Sample answer:** Because worms in the blood might keep the blood from working properly.

[2] **Sample answer:** Because they might use things like water and minerals that plants need.

[3] **Sample answer:** Because plants need minerals in order to grow.

Sample answer for the caption: Because if people eat meat with tapeworms and roundworms, the worms may make them ill.

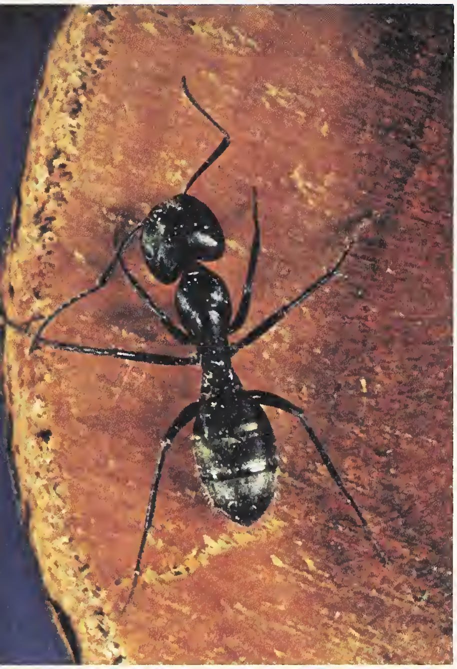
Insects

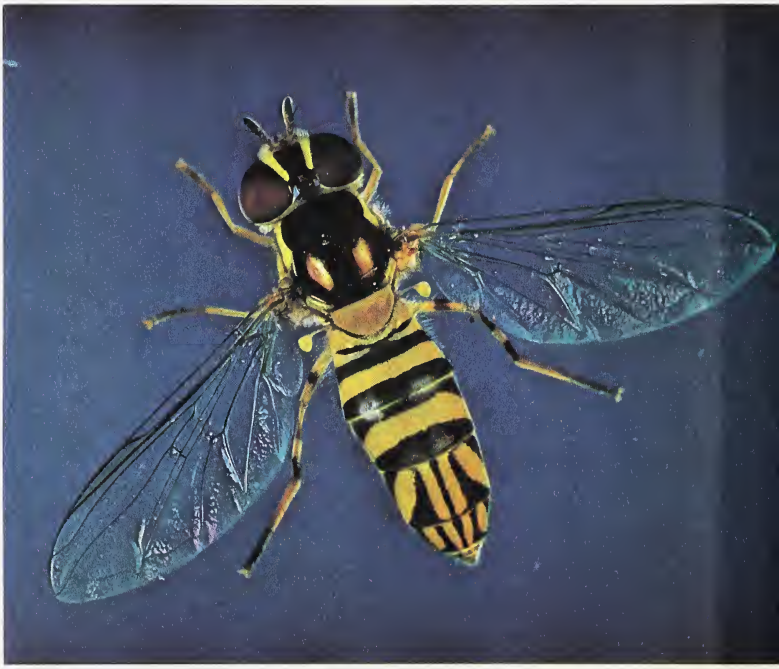
Perhaps you have watched a parade of ants carrying food back to their nest. Or you may have waited for a caterpillar to become a butterfly. Ants and butterflies are two of the fun-to-watch animals called *insects*. What are some other insects you might like to watch?

What are insects like? Most insects are animals that would fit into your minizoo because of their small size. Besides being small, insects are alike in other ways. Look at the picture of the insects on this page. How many pairs of legs does each insect have?[1] How else are these insects alike?[2]

[1] **Sample answer:** Three pairs.

[2] **Sample answer:** They both have a pair of antennae. They both have three body parts.



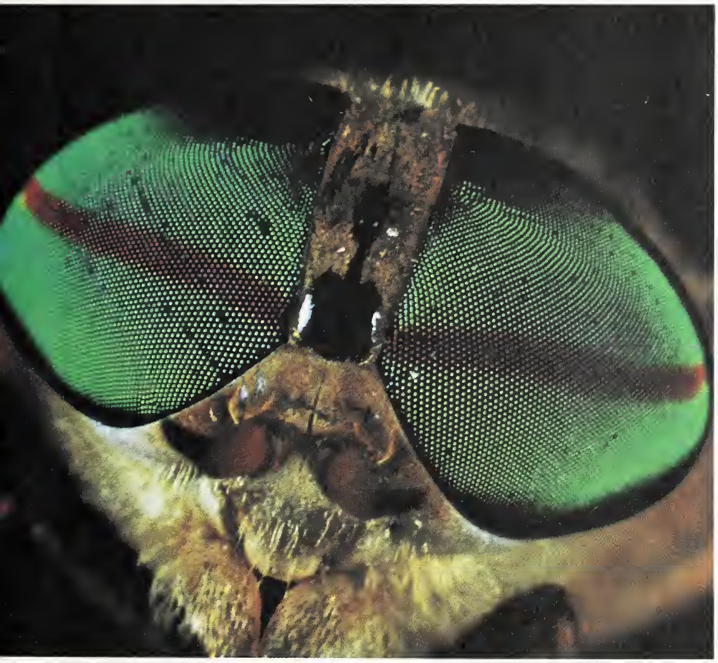


Suggested activity: After discussing "What are insects like?" the pupils may wish to collect and observe some common insects to notice the likenesses and differences among the various kinds of insects.

Have you ever tried to catch a fly? If so, you know it is hard to do. They seem to have eyes in the back of their head. That's because a fly's eyes are different from yours. Your eyes are made so that you see only one picture of what you are looking at. A fly's eyes see many pictures of what the fly is looking at. And the fly can see in every direction. So even if you move only a little bit, a fly will see you move. What is a better way to catch flies than trying to creep up on them? [1]

[1] **Sample answer:** By hanging something such as flypaper on the ceiling.

Insects can move about in many ways. Many insects have wings. Some insects, like bees, have two pairs of wings. Others, like mosquitoes, have just one pair of wings. Fleas, like the ones dogs sometimes get, don't



Suggested activity: The pupils may wish to observe insects or insect parts under a hand lens or microscope if one is available. A fly's compound eyes or a butterfly's wing are particularly interesting to observe under magnification.

Much activity goes on in the hive of honeybees. What activities do you think are going on in this picture?

have any wings. They just jump around. Still other insects crawl around on their legs.

You may know that some insects live together in colonies. Bees live this way. A bee colony may have one *queen,* a few hundred *drones* [drohnz], and over 20,000 *workers.* The queen is larger than any other bee in the colony. She is the only bee that lays eggs. The drones are male bees. They do not do any work in the hive, except to mate with the queen. The drones are fat and lazy. They have to be fed by the workers. Drones cannot even sting you.

The workers are female bees. They do all the work in the hive. They care for the young bees. They gather the sweet juices from the flowers. They even make the honeycomb, where the queen's eggs are laid. What other insects do you know of that live in colonies?[1]

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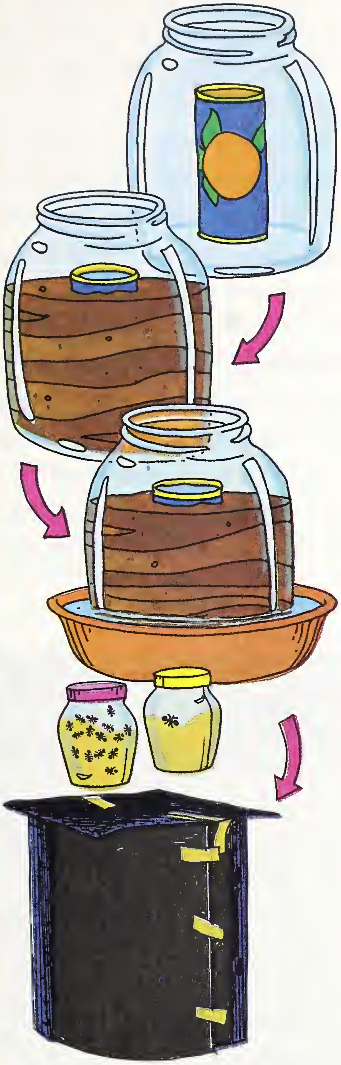
[1] **Sample answer:** Ants, termites, wasps.

Sample answer for the caption: The workers are putting food into the compartments of the honeycomb for the hatched eggs.

Suggested research: After discussing the information about bees on this page, the pupils may wish to learn more about the activities of other insects that live in colonies. Have them look in reference books under *social insects.*



FINDING OUT

How do ants live?

You will need: large, wide-mouthed glass jar; tall, narrow tin can; sandy soil; flat pan of water; black paper; ants from an anthill; 2 small jars with lids; white paper

- Place the empty can in the centre of the large jar.
- Fill in the space between the can and the jar with soil as shown. Fill the can with water so the ants won't get into the can.
- Set the jar in a pan of water. This will keep the ants from escaping.
- Collect the ants in a small jar by laying the jar on its side by an ant nest in a field or yard. A little sugar water in the jar might help draw them into the jar. Gather about 50 ants! Close the jar tightly.
- Dig deeply into the soil to try to find a queen ant.
- Place the soil on white paper. An ant larger than the others is a queen. Although the colony lasts longer with a queen, don't worry if you can't find one. The ants will still be fun to watch.
- Place the queen ant and some of the soil into the other small jar. Close the jar.
- Add some soil from the ant nest to the top of the soil you prepared. Add the ants (the queen last).
- Add food for the ants (bread crumbs, sugar water).
- Wrap the jar with black paper. Wait a few days before you look at the ants. Take the paper off when you want to watch the ants. Put the paper back on when you're not watching.

What things do you notice about the ant colony?

Teaching helps for "Finding Out":
Processes used: observing, communicating.
Sample findings: The pupils will most likely notice the tunnels within the ant colony. They may also notice how the ants communicate with each other. They may even notice that ants sometimes wrestle with each other and carry each other around piggyback.

For You to Think About

The number of insects is greater than the number of any other kind of animal in the world. One reason for this is that insects can survive quite well. Think of some reasons why this might be so.

[1] **Sample answer**: In the tropics, in the jungles.

[2] **Sample answer:** By drying up any standing puddles or by carefully spraying for mosquitoes.

Where can insects be found? A better question might be "Where can insects *not* be found?" Insects are found on the land, in the water, and in the air. For the most part, there are more insects in places that have warmer weather than in places that have cooler weather. Where might some of these warmer places be? 1

Ants live in the soil and in buildings too. Cockroaches live in the cracks in many buildings. Mosquitoes, for part of their life, are found in water that does not flow, such as in puddles and swamps. How do you think you could keep the number of mosquitoes down? 2

Why are insects important? Many insects can carry sickness. You may know that mosquitoes and flies carry sicknesses caused by protozoans. Another kind of insect, the bedbug, can cause a fever with its bite.

Many insects destroy things. Beetles may destroy grains. Caterpillars eat cabbages and the leaves of other

What plants do you know of that might be harmed by insects?

Sample answer for "For You to Think About": Most insects can eat many different things. This makes them quite independent of special food requirements. Many insects have ways to protect themselves against enemies: protective coloration, compound and simple eyes, wings for flight, and offensive odours.

Sample answer for the caption: Wheat, bean, and potato plants.

vegetables. You may also know that moths can make holes in wool sweaters. How can you save your clothes from being eaten by moths? 1

Insects can be very helpful, too. Some insects help plants make their seeds. Bees and other insects carry *pollen* [POL-uhn] from one flower to another. The pollen from one flower causes another flower of the same kind to make seeds.

Insects are used as food by many animals. Many birds eat insects. So do many furry animals. Even fish eat insects.

Insects are helpful in still other ways. Silkworms, the young of a certain moth, make beautiful silk threads. What things do you know of that are made of silk? 2 Other insects lay eggs on the bodies of harmful caterpillars. When the eggs hatch, they destroy the caterpillars. Still other insects help break down dead plants and animals. What other helpful things do insects do? 3

[1] **Sample answer:** By keeping them in plastic bags so that moths cannot lay their eggs on them.

[2] **Sample answer:** Scarves, dresses, shirts.

[3] **Sample answer:** Bees make honey, which some people like to eat, and some insects help loosen the soil by making tunnels.

In what way does the silkworm moth use the silk that it makes?

Suggested activity: After discussing "Why are insects important?" the pupils may wish to find out how insects are supplied for the zoo animals that eat insects. The pupils may wish to visit or write an animal keeper at a zoo to find out how this is done.

Sample answer for the caption: For building a cocoon.

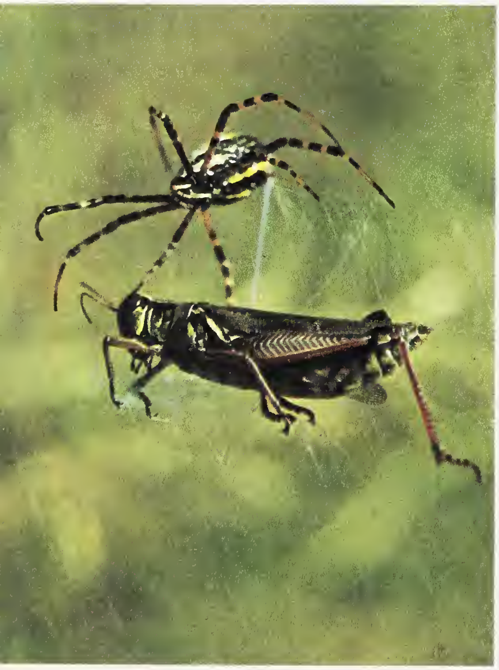
Spiders

Many people think spiders are insects. But they are not. Look at the picture of the insect and the spider on this page. How are the two animals different? 1

[1] **Sample answer:** The spider has four pairs of legs, while the insect has only three pairs.

What are spiders like? One thing you may know about spiders is that they all spin silk threads. The silk comes from silk glands on the spider's body. Spiders also have *spinnerets* [SPIHN-uh-REHTS], which they use for spinning the silk into threads. The spinnerets are like fingers that work with the threads. Some threads are thick. Others are thin. Some threads are more sticky than others. Why do you think this is important when a spider makes a web? 2

[2] **Sample answer:** It helps that some threads are sticky because they help to hold the web together.



Spiderwebs have many shapes. The pictures on the next page show some spiderwebs. The webs all look different. But they are all used to catch insects for food.

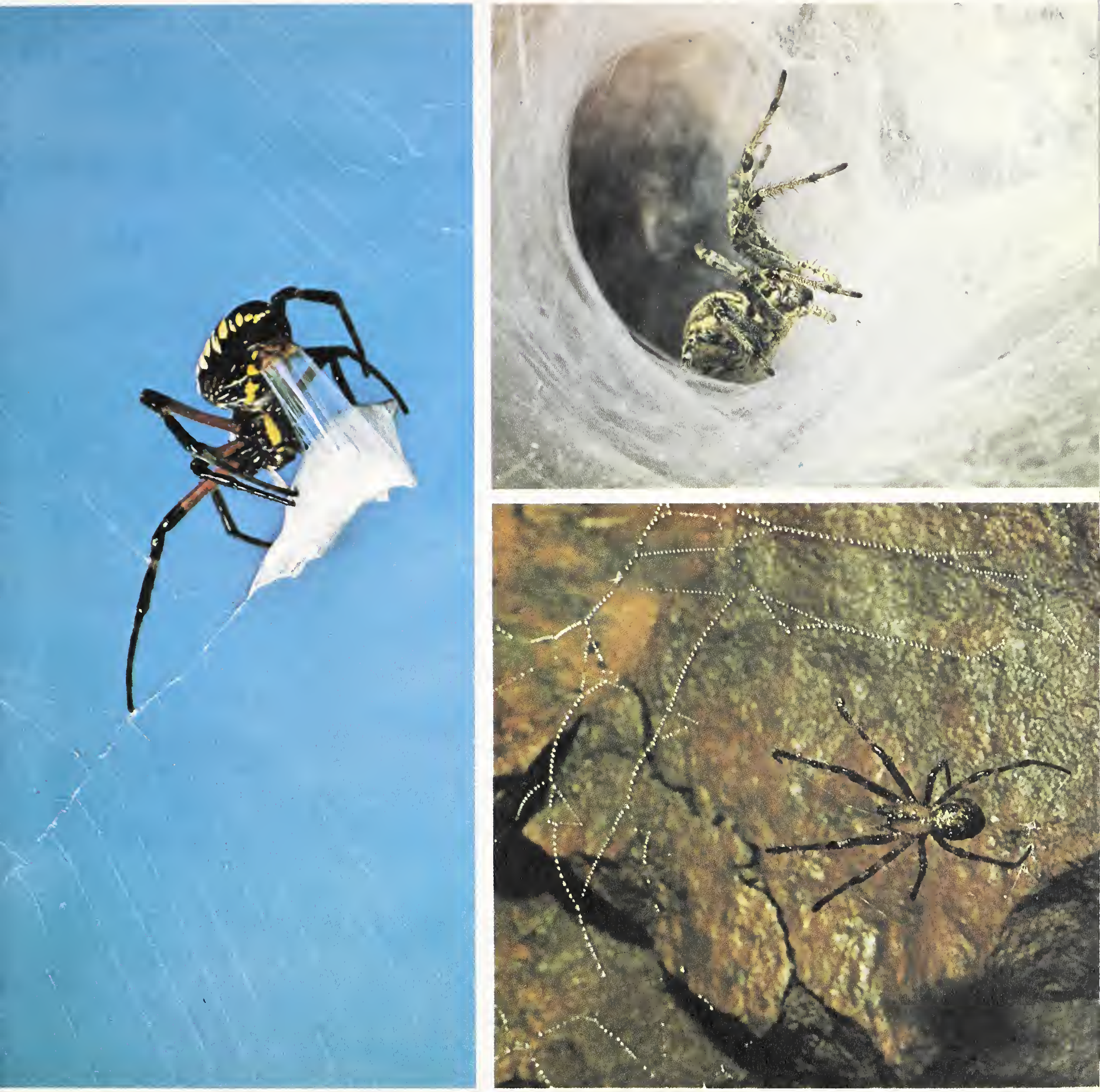
All spiders do not spin webs with their silk. One kind of spider makes a kind of lasso. It spins out a long silk thread with a sticky ball at the end. The ball sticks to the insect the spider wants to catch. The insect often cannot escape.

One important thread spun by all spiders is the dragline. No matter where a spider goes, it is attached to a dragline. Spiders have many enemies, like snakes and birds. They like to eat spiders. If an enemy appears, the spider can often get away by running up the dragline.

There is another interesting thing about spiders. After a spider catches an insect, it fills it with juices to digest it. Soon the insect becomes like soup for the spider's dinner.

Where can spiders be found? You can find spiders in many places. They are often seen in basements. Some can be found in backyards or fields. They spin their webs in

Suggested activity and research: After discussing "What are spiders like?" the pupils may wish to collect different kinds of spiderwebs. They can do this by first spraying the web gently with paint. They should then spray poster paper with adhesive. If they then gently lean the sticky paper against the wet web, the web will adhere to the paper. This might lead the pupils to try to find out what kind of spider made the kind of web they collected. They can find out by looking in reference books under *spiderwebs*.



Teaching helps for the pictures above: A spider in the picture on the left is tying up an insect that was caught in the web. The picture at the upper right shows a spider entering a funnel web it has spun. At the lower right the pupils can see an example of beaded threads on a web. These beaded threads are used to trap jumping or flying insects.

woods and swamps. Some spiders are found in deserts. Others live most of their life underwater. Where have you seen spiders?

Why are spiders important? Some people are afraid of spiders. But very few spiders ever hurt people. Usually spiders are helpful to people. They eat insects, like grasshoppers, that destroy crops. They also eat flies and mosquitoes, which often carry disease.

Most spiders have poison glands. When a spider bites an insect, the insect may die from the poison. Only one spider in North America can hurt people. The bite of the black widow spider is very harmful to people. Why do you think it might be helpful for people to know what this spider looks like?[1]

[1] **Sample answer:** So that they can easily recognize and avoid them.

FINDING OUT

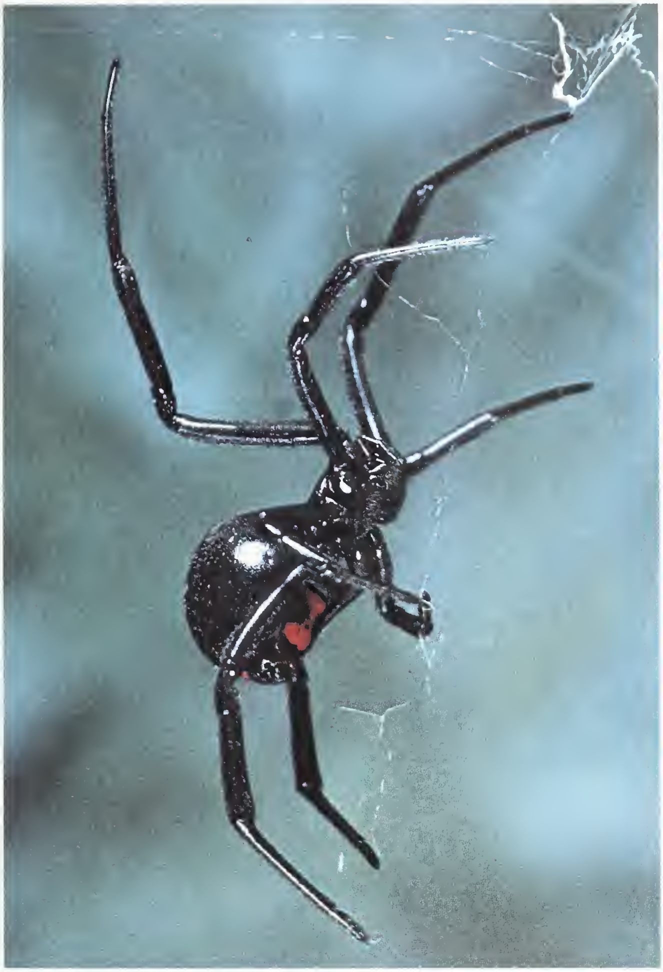
How do spiders live?

You will need: 1 small glass jar, window screening to cover the top of the jar, 1 sprig of leaves, 1 spider, insects for the spider's food (*such as flies and mosquitoes*), *moist cotton*

- Place the branch in the jar. Add the moist cotton.
- Put the spider in the jar and cover the top of the jar with the screening. Keep the cotton moist.
- Add a small, live insect twice a week.

Did the spider spin a web? If so, how long did it take? What else did you notice that spiders do?

Teaching helps for "Finding Out":
Processes used: observing, communicating. *Sample findings:* The pupils may notice that some spiderwebs are made more quickly than others. Some spiderwebs are completed in stages, with intervals of days in between. The pupils may see how the spider captures insects.



The black widow is one of the few spiders whose bite is harmful to people. Why is it important for people to be able to recognize poisonous spiders?

Exploring on Your Own

Many people think that the bite of the tarantula spider is poisonous to people. Look in reference books under *spiders* to see if you can find out why people fear the tarantula.

A Second Look

1. How can you tell an earthworm from a roundworm?
2. In what ways are insects helpful to other living things?
3. How do many spiders catch insects for food?

Sample answers for "A Second Look": 1. An earthworm has rings around its body. A roundworm is smooth. 2. Insects are the food of many animals. They also help plants make seeds by carrying pollen from one plant to another. Some insects destroy other harmful insects. 3. Many spiders use their web to catch insects for food.

Sample answer for the caption: People have to be able to recognize poisonous spiders so that they can avoid them.

Sample findings for "exploring On Your Own": The tarantula is a large, hairy spider, and looks very fierce. In fact, its bite is no more harmful than a bee sting.

Workers Who Use Science

Bacteria are important to people in many ways. For this reason, it is helpful for most people to know some things about bacteria. But there are some people who study many things about bacteria. They are called *bacteriologists* [bak-TIHR-ee-OL-uh-juhsts].

Some bacteriologists work for companies that make foods, like cheese or pickles. These bacteriologists keep the right bacteria growing so that they can be added to the foods. Other bacteriologists work for drug companies. They search for and grow the bacteria that are used in making some medicines.

Other bacteriologists study bacteria which cause people to become sick. They try to find out which bacteria are causing the sickness. They also try to find out just how the bacteria make people sick. Why might knowing these things be important?[1]

Still other bacteriologists study the bacteria in the soil. They study the bacteria that cause dead animals and plants to decay. Bacteriologists try to find ways to use these bacteria to break down certain waste matter from cities and factories.

To find out more about bacteriologists, try to find answers to these questions:

What other things might bacteriologists study about bacteria?[2]

How can a bacteriologist find out which bacteria are causing a certain sickness?[3]

Along with sources of your own, the following book might be helpful: Sullivan, Navin. *Pioneer Germ Fighters.* New York: (Starline) School Book Service, 1972.

Sample answers for "Workers Who Use Science":

[1] Knowing these things may help people avoid diseases caused by bacteria.

[2] Some bacteriologists study how to preserve foods from bacteria that spoil foods.

[3] By blood tests and other tests.

Reviewing the Main Ideas

Bacteria are tiny one-celled living things.
Some bacteria can get into your body and cause you to become sick.
Some bacteria give certain foods the taste people like.
Protozoans are tiny one-celled animals.
Protozoans are important in the food chains of many animals.
Algae are water plants that can make their own food because they have chlorophyll.
Fungi are small plants that cannot make their own food because they do not have chlorophyll.
Mosses are small green plants that do not have tubes in their roots, stems, and leaves, as bigger green plants do.
There are many kinds of worms. Some worms are flat. Some are round. Others are round with many rings around their body.
Although insects can be harmful to other living things, they can also be helpful.
Some insects live together in colonies.
Many spiders are helpful to people because they eat insects that destroy crops.
Spiders spin silk threads to help them catch their food.

Reading About Science

Ewbank, Constance. *Insect Zoo*. Pickering, Ontario: Beaverbooks, 1973.
Hutchins, Ross E. *Insects and Their Young*. Toronto, Ontario: Dodd, Mead & Company (Canada) Ltd., 1975.
Pitt, Valerie and Cook, David. *A Closer Look at Ants*. Toronto, Ontario: Grolier Limited, 1975.

Reviewing the unit: You may wish to have the pupils study "Reviewing the Main Ideas" to help prepare for "Testing for Understanding" on page 46. **For further reading:** You may wish to encourage the pupils to read the books listed under "Reading About Science" and other books and articles related to the topic of small living things. Such articles may be found in reference books under *microbes*, *fungi*, and *insects*.

Testing for Understanding

Ideas to Check

On your paper write *T* for each sentence below that is true. Write *F* for each one that is false.

T 1. Some bacteria cause dead animals and plants to decay.
F 2. The drones do all the work in a bee colony.
T 3. Algae are the most important link in the food chain in water.
T 4. Spiders spin a dragline to help them escape from their enemies.
F 5. Bread molds are plants called mosses.
T 6. Earthworms help make the soil better for plants to grow in.
F 7. Fungi are plants that make their own food.

Words to Use

Write on your paper the word that best fits in each blank below. Choose from these words: *roundworms, spiders, bacteria, protozoans, chlorophyll, spores, honey, yeasts, freezing, insects.*

1. —— change the taste of some foods. bacteria
2. Plants which make their own food have something green called ——. chlorophyll
3. Mushrooms reproduce by means of ——. spores
4. —— help plants make their seeds by carrying pollen from one plant to another. insects
5. —— food is one way to keep it from being spoiled by bacteria. freezing
6. When someone eats meat from a pig that is not cooked enough, that person may get sick from ——. roundworms
7. —— spin threads to help them catch insects for food. spiders
8. —— are fungi that make bread light and good to eat. yeasts

Suggestions for evaluation: You may wish to use the test questions provided under "Testing for Understanding" to evaluate the pupils' understanding of the main ideas and important words of this unit. Additional test questions for the unit "Small Living Things" are provided for you on page T16 of the Teacher's Manual. These test questions may be duplicated for classroom use. Answers to these additional test questions can be found on page T22 of the Teacher's Manual.

Having Fun with Science

What Am I?

I have a trunk like an elephant,
And I'm flat like a tie.
But I'm smaller than an elephant,
Even smaller than a fly. *What am I?*[1]

My shape's like the sole of a shoe,
But my size makes me hard to view. *What am I?*[2]

I grow in your basement on shoes and old clothes.
I give off a smell that bothers your nose. *What am I?*[3]

Pretend Jingles

Complete the jingles with one of these words: *earthworm, euglena, ant, spider, bee, amoeba.*

If you were a(n) ——, you'd catch insects with silk.[1]
If you were a(n) ——, you would eat with your "feet."[2]
If you were a(n) ——, you'd have rings that go around you.[3]
If you were a(n) ——, you'd make honey that's sweet.[4]

Things to Do

1. Carefully remove the stalk of a mushroom. Lay the cap right side up on a piece of white paper. After a day, lift the cap to see the "print" left by the cap. See if you can figure out what caused this print.

2. Watch a caterpillar change into a butterfly or a moth! Find a caterpillar and put it in a wide-mouthed jar. Add 3 or 4 fresh leaves and some moist cotton. (Be sure the caterpillar always has enough leaves and that the cotton is always moist.) Punch holes in the lid of the jar. Put the lid on the jar. Be patient. It may take a few weeks for the caterpillar to change.

For further involvement: You may wish to use "Having Fun with Science" to involve the pupils in fun activities that reinforce some of the main concepts of the unit "Small Living Things." You may also wish to encourage the pupils to make up additional activities related to small living things.

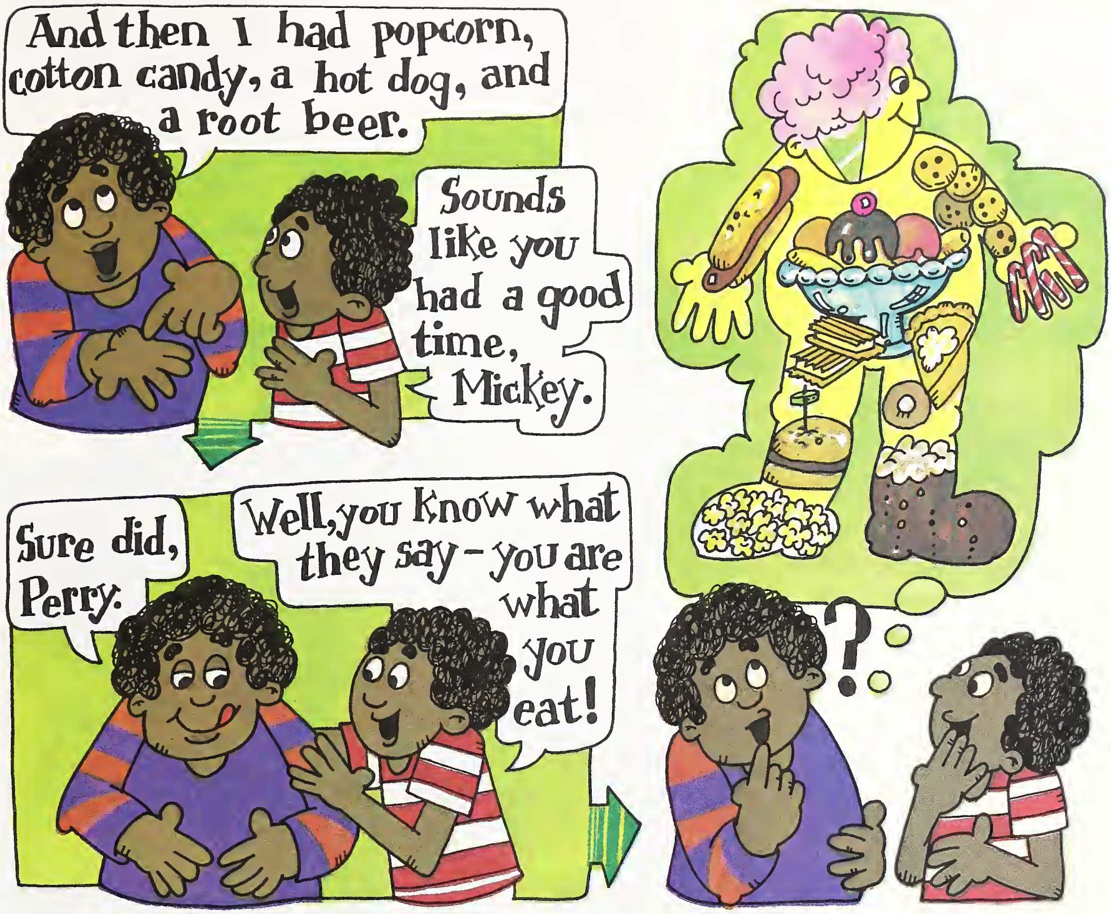
Answers for "What Am I?": [1] Planarian. [2] Paramecium. [3] Fungi.

Answers for "Pretend Jingles": [1] Spider. [2] Amoeba. [3] Earthworm. [4] Bee.

2 Your Body

1 What makes up your body?
2 Some systems of your body
3 How can you help your body work properly?

Preparing for the unit: For a list of instructional materials helpful in teaching this unit, see page T13 of the Teacher's Manual. You may also wish to check the list of materials needed for each "Finding Out" activity in this unit, and have the pupils begin collecting these materials. These activities are found on pages 56, 61, 67, 69, 71, 77, 79, and 82.


And then I had popcorn, cotton candy, a hot dog, and a root beer.
Sounds like you had a good time, Mickey.
Sure did, Perry.
Well, you know what they say – you are what you eat!
?

What do you think Perry meant when he said, "You are what you eat"?[1]

Do you agree with Perry? Why or why not?[2]

Introducing the unit: You may wish to have the pupils read the cartoon above. Then have the pupils read the questions below the cartoon and discuss their answers to the questions.

Sample answers for questions below the cartoon:

[1] I think that Perry meant that your body breaks down and uses the food you eat for growth.

[2] Yes. Many food parts help make up my body.

1 What makes up your body?

Dogs. Roses. Ants. These are just a few of the many kinds of living things found on the earth. Each kind is different in many ways. What are some ways that dogs, roses, and ants are different? [1] What are some other living things you know of? In what ways are they different? [2]

[1] **Sample answer:** Dogs have fur and move on four legs. Roses do not move from place to place and are partly green. Ants are very small and have antennae.

[2] **Sample answers:** Birds have feathers and fly. People move on two legs and talk.

Main concepts of the chapter (pages 50–57):
Cells are tiny units of living matter.
Cells of the same kind join together in your body to form tissues.
Tissues with much the same jobs join and work together to form organs.
Organs working together make up a system.

Performance objectives: After studying the information provided in this chapter, the pupils should be able to
—explain what cells are;
—name the four main groups of tissues, and state why each group is important to their body;
—explain what organs are made up of;
—explain what a system is made up of.

Important words: cells, oxygen, tissue, connective tissue, epithelial tissue, muscle tissue, nerve tissue, organ, system, digestive system, circulatory system.

Cells

Though living things are different in many ways, living things are alike in one special way. That is, living things are made up of one or more *cells*. Cells are tiny units of living matter. Do you think all living things are made up of the same number of cells? Why or why not?[1]

In general, cells are so small that they can be seen only with the aid of a microscope. For this reason, it takes many cells to make up the body of most living things. Your body, for example, is made up of billions of cells.

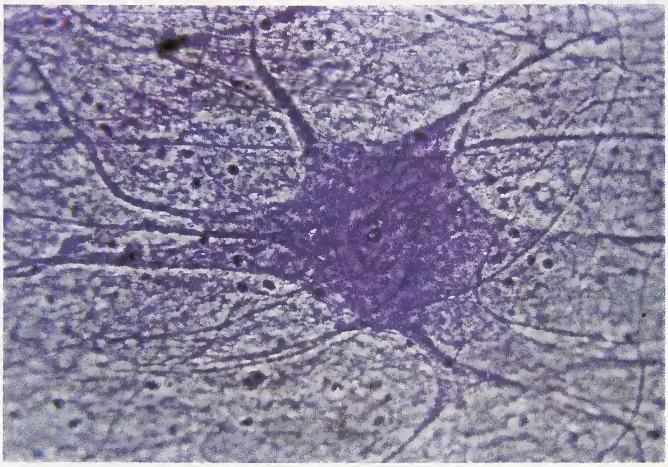
Exploring on Your Own

All living things are made up of cells. See if you can find out what is inside a cell. Also see if you can find out how scientists study what is inside a cell. Looking in reference books under the headings *cytology* or *cells* may help you.

[1] **Sample answers:** No. Because all living things are not the same size.

Sample findings for "Exploring on Your Own": The inside of a cell has chromosomes, a nucleus, protoplasm, centrosomes and many other parts. Scientists use powerful electron microscopes and stains to study cells.

The cell in this picture is called a nerve cell. The long, threadlike parts of nerve cells help carry "messages" from one nerve cell to another. What might some of these "messages" be?



Though most cells are very small, they do many of the same things that all living things do. For instance, most cells take in a gas called *oxygen* [OK-sih-juhn]. Cells also grow. What else do you think most cells do? [1]

Just as there are many kinds of living things, there are also many kinds of cells. Each kind of cell has a different shape. Each kind of cell does special jobs. What do you think the jobs of some of your body cells might be? [2]

Tissues

Since most cells are very small, they may not be able to do some of their jobs alone. Because of this, cells of the same kind often join and work together. When cells of the same kind join together in your body, they form a larger part of your body. This part is called a *tissue* [TIHSH-oo].

[1] **Sample answer:** Take in food, give off wastes.

[2] **Sample answer:** Some muscle cells tighten and relax to help move my body. Bone cells are hard and help protect my body.

Sample answer for the caption: About something being touched, about something being looked at.

Connective tissue. There are four main groups of tissues in your body. One of these groups is called *connective tissue*. Where in your body might you find connective tissue?[1] What do you think this group of tissues does to help you?[2]

There are several kinds of connective tissue in your body. One kind makes up your bones. Your bones help protect parts of your body such as your brain, heart, and stomach. How do your bones protect these parts of your body?[3] What other parts of your body do you think your bones protect?[4] How else are your bones helpful to you?[5]

Stop for a moment and rest one of your arms on something such as your desk. With your other hand, touch your resting arm just inside your elbow. You should be able to feel a thin, cordlike part of your body. This part is made up of another kind of connective tissue. This kind helps hold your bones together. Besides inside your elbow, where in your body can you feel this kind of connective tissue?[6]

For You to Think About

What might you be like if you had no connective tissue in your body?

[1] **Sample answer:** In my nose, legs, arms, head.

[2] **Sample answer:** Makes up the hard parts of my body so I can stand and walk. Holds parts of my body together so it has shape.

[3] **Sample answer:** My bones are hard and keep things from injuring other parts of my body.

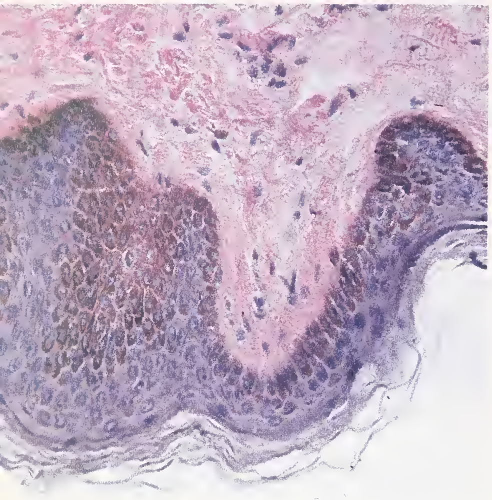
[4] **Sample answer:** My lungs and eyes.

[5] **Sample answer:** My bones help me move.

[6] **Sample answer:** Behind my knee, behind my ankle.

Suggested discussion: When discussing "Connective tissue," you may want to point out to the pupils that the kind of connective tissue that helps hold their bones together is flexible, unlike bones. You might then want to ask the pupils this question: Why do you think it is important that some kinds of connective tissue are flexible? (Sample answer: To help move bones at joints.)

Sample answer for "For You to Think About": Since I would have no bones, I would not be able to walk or move my arms or legs.



This layer of epithelial cells helps make up the skin. Why do you think it is important that these cells form a layer?

Epithelial tissue. Another main group of tissues is known as *epithelial* [EHP-uh-THEE-lee-uhl] *tissue.* One kind of epithelial tissue helps make up your skin. Other kinds of epithelial tissue line the inside walls of many parts of your body. For example, the inside of your mouth is lined with epithelial tissue. The inside of your nose is also lined with epithelial tissue. Epithelial tissue helps to protect these and other parts of your body. How do you think this group of tissues protects parts of your body?[1]

Muscle tissue. One of the largest of the main groups of tissues is called *muscle* [MUHS-uhl] *tissue.* This tissue makes up the muscles of your body. Where are some muscles found in your body?[2] What do these muscles help you to do?[3]

Your body is made up of three kinds of muscles. One kind is connected to your bones. When you move your arms or legs, you make this kind of muscle work. What other parts of your body can you move because of this kind of muscle?[4]

Another kind of muscle makes up your heart. This kind helps move blood through your body. You cannot make your heart muscle work. This muscle works without your having to think about it.

There is still another kind of muscle. This kind makes up the walls of certain parts of your body besides your heart. For instance, this kind of muscle makes up the walls of your stomach. The muscles in these walls help move food through your stomach. You cannot make this kind of muscle work. Do you think it is important that some muscles in your body work without your having to think about them. Why or why not?[5]

[1] **Sample answer:** It covers parts of my body to help keep out germs and to help keep these parts from being injured.

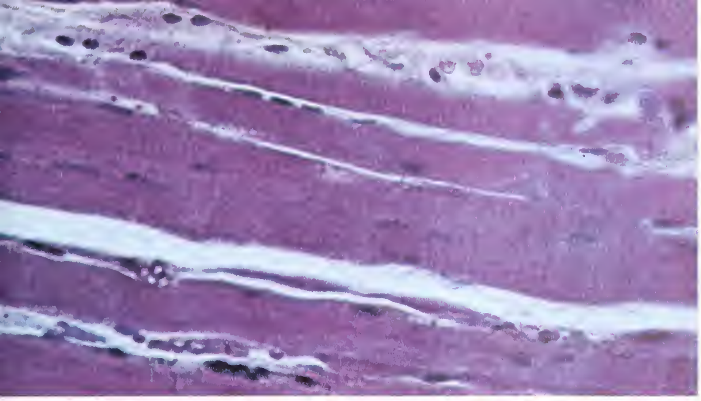
[2] **Sample answer:** In my arms and legs.

[3] **Sample answer:** They help me to move, run and write.

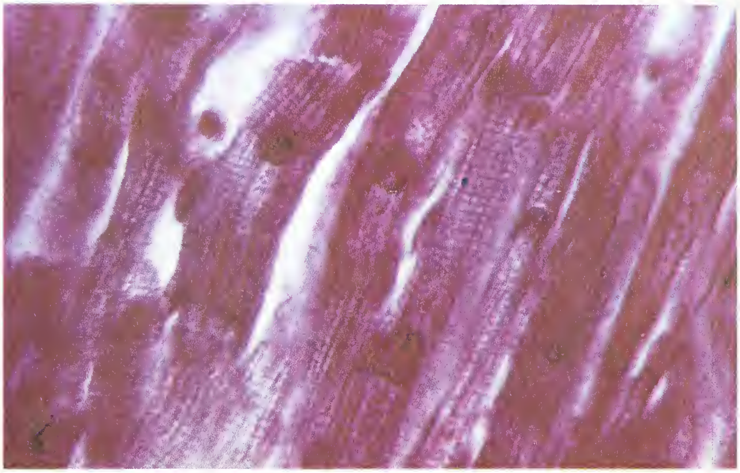
[4] **Sample answer:** My back, fingers, and toes.

[5] **Sample answers:** Yes. Because if I had to think about making my heart work, I would not be able to sleep.

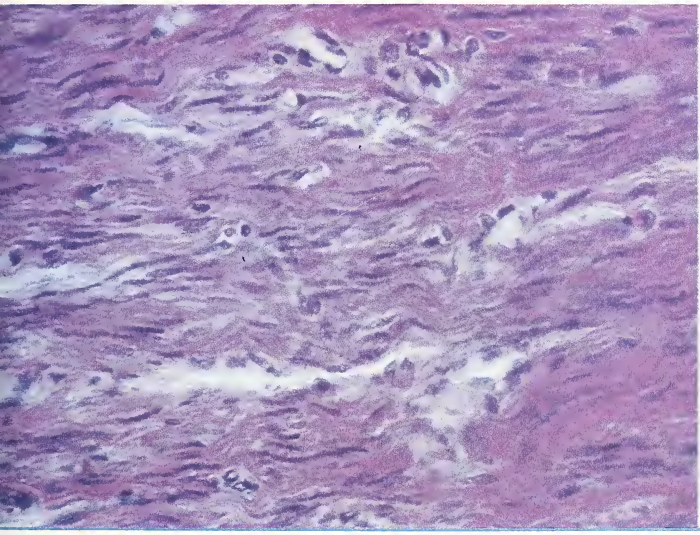
Sample answer for the caption: Because layers of cells help protect the body.



Bone Muscle



Heart Muscle



Stomach Muscle

Suggested activity: In conjunction with the "Finding Out" on page 56, you may wish to involve the pupils in an activity which would help them discover more about the muscle tissue pictured above. Have the pupils get the heart and stomach of a chicken (perhaps from a meat market) and compare the muscle tissue of these organs with the bone muscle tissue of the chicken leg.

Nerve tissue. Still another main group of tissues is *nerve tissue*. Your brain, spinal cord, and nerves are made up of nerve tissue. How do you think this group of tissues helps you?[1]

Did you ever touch something that was sharp or hot or cold? What did you do after you touched it?[2] Your nerve tissue helps you know what you are touching. What else do you think nerve tissue helps you to do?[3]

[1] **Sample answer:** It helps me feel things when I touch them, and it helps me think.

[2] **Sample answer:** I pulled away from it.

[3] **Sample answer:** See and hear things.

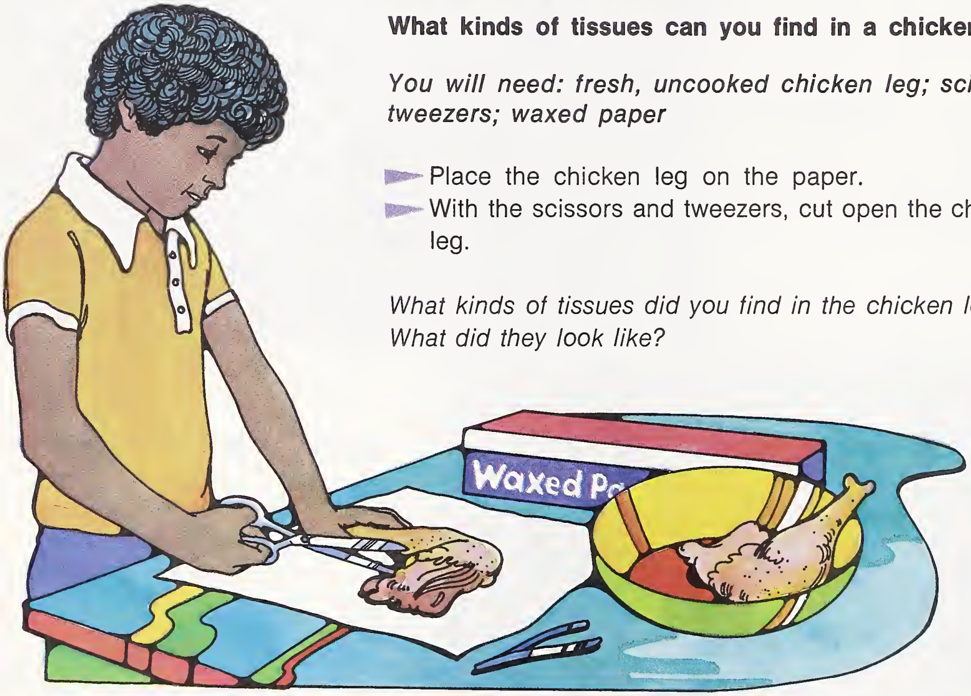
FINDING OUT

What kinds of tissues can you find in a chicken leg?

You will need: fresh, uncooked chicken leg; scissors; tweezers; waxed paper

- Place the chicken leg on the paper.
- With the scissors and tweezers, cut open the chicken leg.

What kinds of tissues did you find in the chicken leg? What did they look like?



Teaching helps for "Finding Out":
Processes used: observing, communicating.
Sample findings: The pupils will most likely find connective tissue (bones, tendons), epithelial tissue (skin), and muscle tissue in the chicken leg. The pupils may describe the connective tissue as brown-white and white; the epithelial tissue as yellow with bumps; the muscle tissue as pink or red.
Extending the "Finding Out": At this time, you may wish to have the pupils compare the tissues by feeling and pulling them. You might then have the pupils discuss their findings.

Organs

Just as most cells of your body are too small to work alone, most tissues are too small to work alone. Tissues with much the same jobs join and work together. These tissues form larger parts of your body which are known as *organs*. Your stomach, eyes, and skin are organs. What other parts of your body do you think are organs?[1]

Systems

Like cells and tissues, organs of your body do not often work alone. Most organs work with other organs. A group of organs working together is called a *system*. Your mouth, stomach, and liver are organs which work together. These organs help make up your *digestive* [dy-JEHS-tihv] *system*. Your heart and blood vessels are also organs. These organs help make up your *circulatory* [SUR-kyuh-luh-TOHR-ee] *system*. What other systems of your body do you know of? What are some organs that help make up these systems?[2]

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[1] **Sample answer:** My brain, lungs, and heart.

[2] **Sample answers:** My muscular system is made up of bone muscle, heart muscle, and stomach muscle. My nervous system is made up of my brain, spinal cord, and nerves.

A Second Look

1. What are cells?
2. What are some tissues of your body, and why are they important?
3. What makes up the organs of your body?
4. What makes up the systems of your body?

Sample answers for "A Second Look": 1. Cells are tiny units of living matter that make up the body of most living things. 2. Connective tissue makes up my bones, which help protect many parts of my body. Epithelial tissue helps make up my skin, which helps protect my body. Muscle tissue makes up my muscles, which help me move and which help move blood through my body. Nerve tissue makes up my nerves, which help me tell if something is hot, cold, or sharp. 3. Tissues with much the same jobs join and work together to form organs. 4. A group of organs makes up a system.

2 Some systems of your body

[1] **Sample answer:** My muscular system helps me move and moves blood through my body. My digestive system breaks down food for my body to use.

[2] **Sample answer:** They depend on my skeletal system for protection. They depend on my circulatory system to carry food to them.

Your body is made up of many systems. Each system does several things. To do these things, each system depends on other systems of your body. What are some things that the systems you know of do?[1] How do you think these systems depend on other systems to do these things?[2]

Main concepts of the chapter (pages 58–74):

Your circulatory system carries things to and from your cells.

Your respiratory system takes oxygen into your body and passes carbon dioxide out of it.

Your digestive system breaks down foods so that they may be used by your cells.

Performance objectives: After studying the information provided in this chapter, the pupils should be able to

—describe how their circulatory system carries things to and from their cells;

—explain how oxygen is taken into their body and carbon dioxide is passed out of their body;

—describe how their digestive system breaks down foods.

Important words: plasma, lungs, arteries, capillaries, veins, mucus, trachea, diaphragm, respiratory system, saliva, esophagus, small intestine, liver, pancreas, villi, large intestine.

Your circulatory system

One of the most important systems of your body is your *circulatory system.* The main job of this system is to carry food, oxygen, and other things to the cells of your body. What do you think would happen if your circulatory system could not carry these things to your cells?[1]

Your circulatory system also carries things away from your cells. Some of these things are wastes. Your cells give off these wastes when they use food and oxygen. What part of your circulatory system do you think carries wastes away from your cells?[2]

Your blood. Have you ever skinned one of your knees? Have you ever cut one of your fingers? If you have, you probably saw some blood. Your blood is one of the parts of your circulatory system.

It is your blood that carries things to and from your cells. Different parts of your blood carry different things. One part of your blood carries food and wastes. This part is called *plasma* [PLAZ-muh]. Plasma is a clear, yellow fluid. Another part of your blood carries oxygen. This part is known as your *red blood cells.* How do you think your blood reaches the cells of your body?[3]

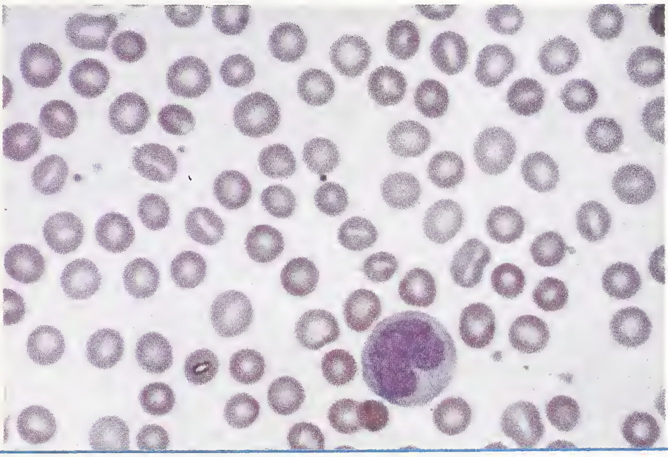
[1] **Sample answer:** My cells would die.

[2] **Sample answer:** My blood.

Exploring on Your Own

Along with your plasma and red blood cells, some other things help make up your blood. Two of these things are white blood cells and platelets. See if you can find out how these things help you. You may do this by looking in reference books.

[3] **Sample answer:** It is pumped by my heart through my blood vessels.



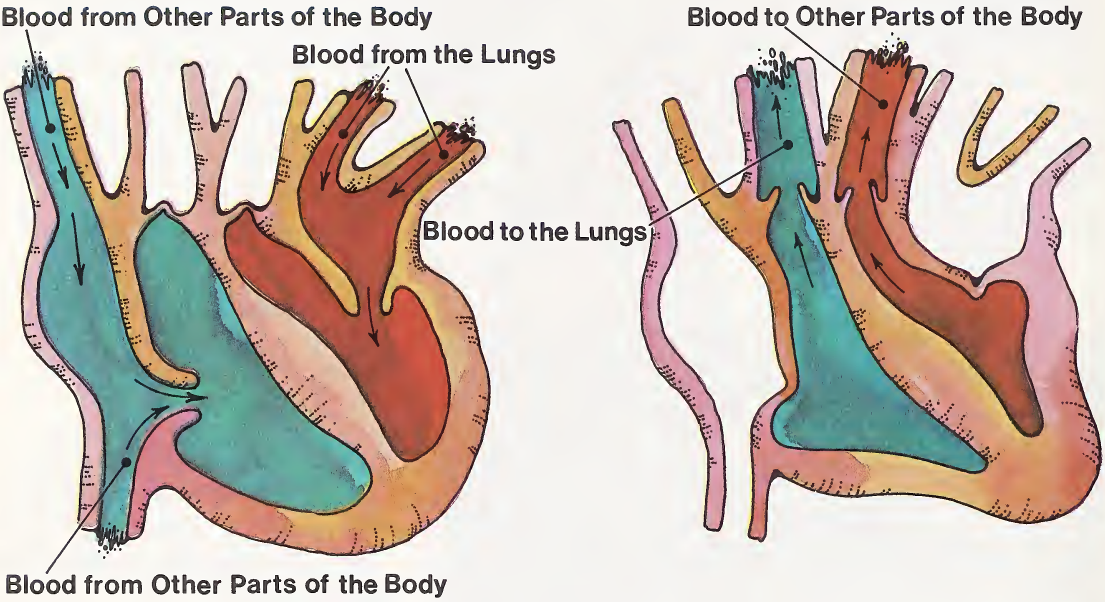
As this picture shows, there are many more red blood cells than other kinds of cells in the blood. Why do you think you need many red blood cells?

Sample findings for "Exploring on Your Own": White blood cells destroy bacteria which may cause disease. Platelets help in clotting blood.

Sample answer for the caption: In order to carry oxygen needed by every part of my body.

Your heart. At some time, you may have put your hand on your chest and felt your heart beating. The beating you felt is caused by the muscle of your heart tightening and relaxing. When your heart muscle tightens, it pushes blood out of your heart. This blood goes to all parts of your body. What do you think happens when your heart muscle relaxes? [1]

The pictures below show how blood moves through your heart. As you can see, one side of your heart takes in blood from two organs. These organs are your *lungs*. The other side of your heart takes in blood from the other parts of your body. Do you think the blood from your lungs is different than the blood from the other parts of your body? If so, how? [2]


Blood from Other Parts of the Body
Blood from the Lungs
Blood to Other Parts of the Body
Blood to the Lungs
Blood from Other Parts of the Body

[1] **Sample answer:** Blood goes into my heart.

[2] **Sample answers:** Yes. It carries oxygen. Blood from the other parts of my body has no oxygen because the cells of my body have taken the oxygen from the blood.

Suggested activity and discussion: After discussing "Your heart," you may wish to have the pupils learn more about how blood travels through the heart. Have the pupils examine the heart of a cow from the meat department of a grocery store. Have the pupils cut the heart in half from top to bottom and compare the inside with the inside of the heart in the picture above. You may then want to point out the valves of the heart and ask this question: Why do you think these valves are important? (Sample answer: To keep the blood going in only one direction.)

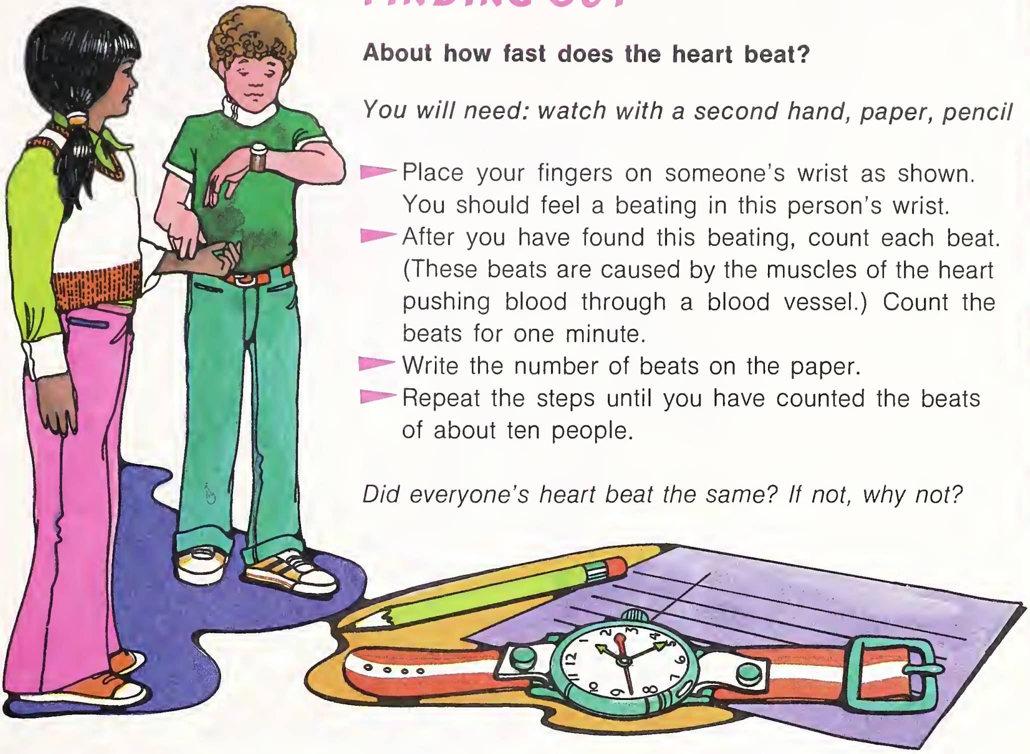
FINDING OUT

About how fast does the heart beat?

You will need: watch with a second hand, paper, pencil

- Place your fingers on someone's wrist as shown. You should feel a beating in this person's wrist.
- After you have found this beating, count each beat. (These beats are caused by the muscles of the heart pushing blood through a blood vessel.) Count the beats for one minute.
- Write the number of beats on the paper.
- Repeat the steps until you have counted the beats of about ten people.

Did everyone's heart beat the same? If not, why not?



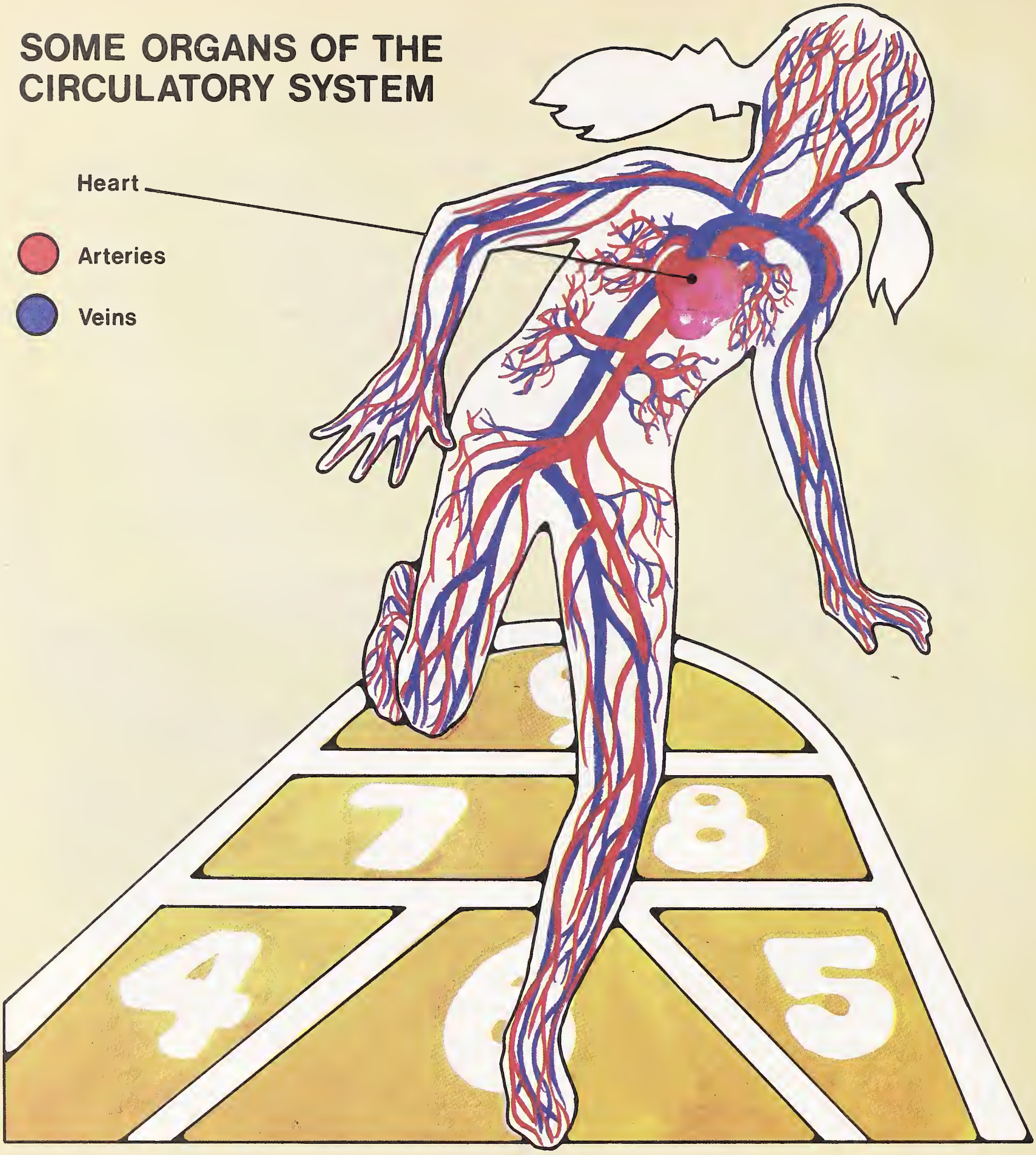
Your blood vessels. Still another part of your circulatory system is your blood vessels. These organs are tubes which carry your blood to and from your heart.

There are several kinds of blood vessels in your body. One kind carries your blood away from your heart. These blood vessels are called *arteries*. Your arteries carry blood which has oxygen and food. How do you think this oxygen and food get into your blood?[1]

[1] **Sample answer:** They go through the walls of my blood vessels.

Teaching helps for "Finding Out":
Processes used: observing, using numbers, measuring, collecting data, comparing, inferring.
Sample findings: The pupils will probably find that everyone's heartbeat is not the same. The pupils may infer that the rate of heartbeat has to do with a person's body size and health.
Extending the "Finding Out": At this time, you may wish to have the pupils take the pulse of some people after they have been sitting down for two minutes and after they have been running in place for two minutes. You might then ask the pupils these questions: Was everyone's heartbeat the same each time you counted it? If not, why not? (Sample answers: No. Because during exercise the heart works harder than it does at rest to supply blood to the parts of the body being exercised.)

SOME ORGANS OF THE CIRCULATORY SYSTEM



Suggested research: After discussing "Your blood vessels" on pages 61, 62, and 63, you may wish to have the pupils find out how veins and arteries help keep the blood moving throughout the body. The pupils might do this by looking in reference books under the headings *arteries, veins,* and *circulatory system.*

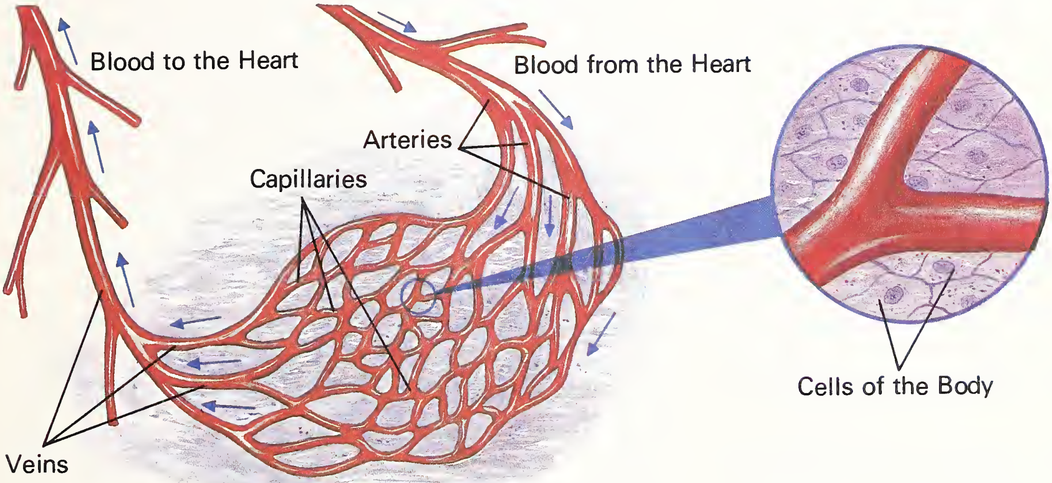
If you look at the picture on page 62, you can see that arteries are different sizes. The arteries near your heart are very large. These arteries branch off into smaller arteries. Why do you think the arteries near your heart are larger than the other arteries of your body?[1]

The smallest arteries in your body branch off into even smaller blood vessels. These tiny vessels are known as *capillaries*. The walls of your capillaries are only about one cell thick. Because of this, oxygen and food in your blood pass easily through the walls of your capillaries into the cells of your body. Also, wastes from your cells pass easily through the walls of your capillaries into your blood.

Your capillaries lead into larger blood vessels called *veins*. Your veins carry blood to your heart. This blood has wastes from your cells. Like your arteries, your veins are different sizes. Why do you think this is so?[2]

[1] **Sample answer:** Large arteries are needed to take the pressure of a large amount of blood being pumped from my heart. The large arteries help keep my blood moving through my body. Small arteries are needed in other parts of my body to carry blood to small parts of my body.

[2] **Sample answer:** Large veins are needed to carry large amounts of blood from my body back into my heart.



Suggested activity: If you have access to a microscope or a microprojector, you may wish to use this instrument to help the pupils observe the flow of blood through the capillaries of a frog or a fish. First, gently wrap a live frog or fish in a moist towel. Have a pupil hold the animal gently near the instrument. If you are using a frog, have a pupil spread one of the frog's webbed feet apart and hold it on the stage of the instrument. Then have the pupils observe the capillaries between the toes of the frog. If you are using a fish, have the pupil spread out the fish's tail on the stage to observe the blood in the capillaries. Have the pupils return the fish to water after two or three minutes.

Your respiratory system

As stated before, your circulatory system carries oxygen to your cells. In order to have the oxygen your cells need, this system must have help from your *respiratory* [REHS-p(uh)ruh-TOHR-ee] *system.* Your respiratory system takes oxygen into your body. How do you think this system takes oxygen into your body?[1] How do you think the oxygen gets from your respiratory system to your circulatory system?[2]

Breathing in. Your respiratory system is often called your breathing system. When you breathe in, this system takes in air. Air is made up of gases, including oxygen.

As you breathe, air passes through many organs. Most of the air you breathe in passes through your *nose* first. What other organ does the air you breathe in sometimes pass through first?[3]

Several things happen as air passes through your nose. For instance, blood vessels in your nose warm the air. Also, certain things in your nose clean the air. One of these things is a wet, sticky material called *mucus* [MYOO-kuhs]. The other things are *hairs.* Mucus and hairs clean the air by trapping things such as dust. Why do you think air needs to be warmed before it goes further into your body?[4] Why does the air need to be cleaned?[5]

After air has been warmed and cleaned in your nose, it goes down your throat. From your throat, the air enters a long tube. This tube is your *trachea* [TRAY-kee-uh], or windpipe. Like your nose, your trachea has mucus. Why do you think it is important for your trachea to have mucus?[6]

[1] **Sample answer:** By taking in air through my nose and mouth.

[2] **Sample answer:** By passing from my lungs into the blood in my blood vessels.

[3] **Sample answer:** My mouth.

[4] **Sample answer:** Because my body is warm, and cool air might cause my body temperature to be lowered, which might keep my body from working properly.

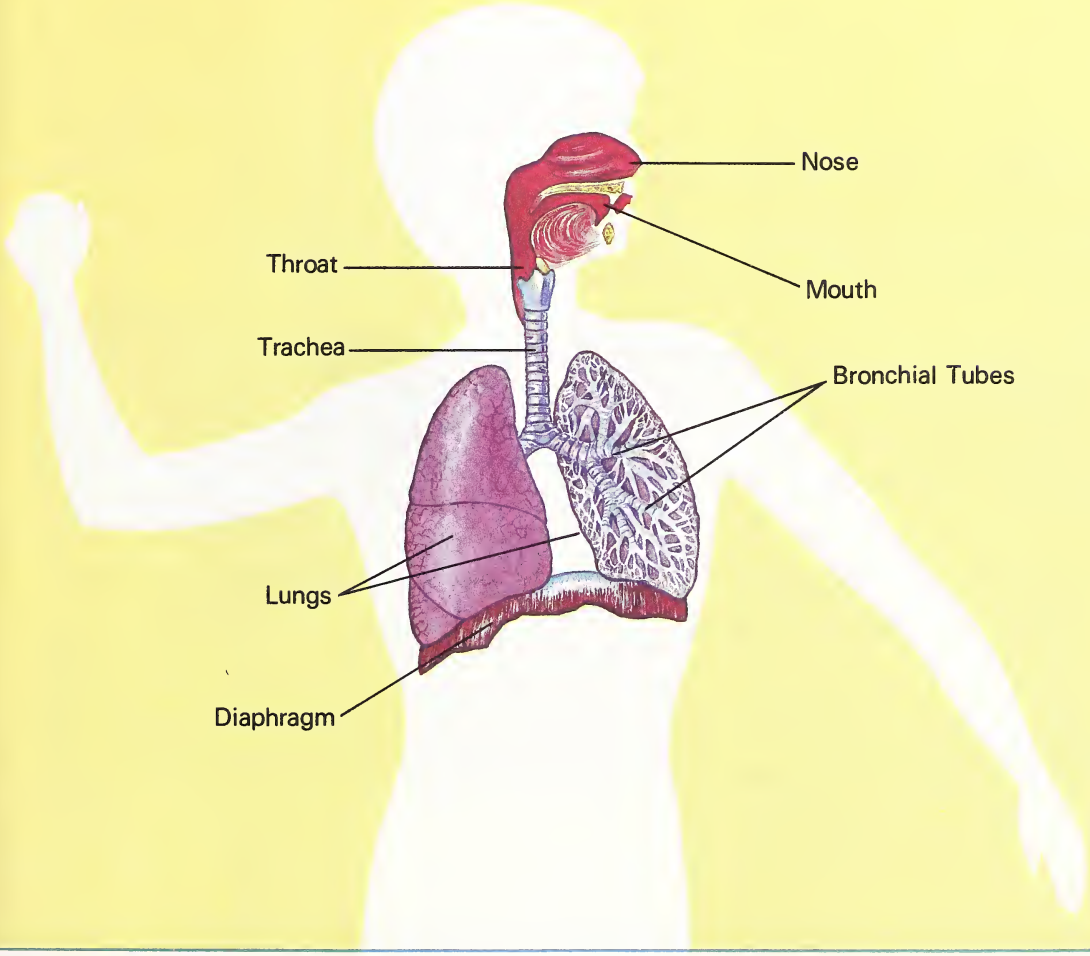
[5] **Sample answer:** To keep things out of my body that might cause disease.

[6] **Sample answer:** It is important so that things which were not trapped in my nose are kept out of my lungs.

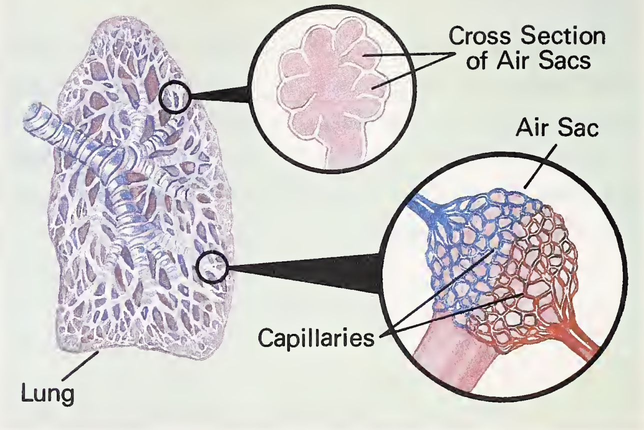
Your trachea branches off into two tubes. The air goes through these tubes into your *lungs*. Inside your lungs, the air goes through many smaller tubes. Finally, the air reaches millions of tiny sacs. These sacs, which are called *air sacs*, have very thin walls. Why do you think this is important?[1]

[1] **Sample answer:** It is important that air sacs have thin walls so oxygen can pass easily from my lungs into my blood.

SOME ORGANS OF THE RESPIRATORY SYSTEM



Suggested activity: At this time, you may wish to involve the pupils in an activity that would help them discover more about the lung. Have the pupils get the lung of a chicken or cow from the meat department of a grocery store and examine the tissue of this organ. You might then wish to ask the pupils why they think the lung tissue feels light and spongy. (Sample answer: Because it is made up of many air sacs.)



For You to Think About

Do you think all animals breathe the same way you do? Why or why not?

As you can see in the picture above, air sacs are surrounded by capillaries. Oxygen from the air in the air sacs passes into these capillaries. From these capillaries, your blood carries the oxygen to the cells of your body. What happens to the parts of the air that are not taken into your blood from your lungs? 1

Breathing out. When your cells use oxygen, they give off a waste. This waste is a gas called *carbon dioxide* [KAHR-buhn dy-OK-SYD]. Carbon dioxide passes into your blood from your cells. Your blood carries this waste to the capillaries in your lungs. From the blood in these capillaries, the carbon dioxide passes into your air sacs. Then the carbon dioxide mixes with air that is in your air sacs. At this point, you begin to breathe out.

When you breathe out, the air with carbon dioxide goes up the organs of your respiratory system. Finally, you breathe the air out of your body. How do you think you are able to breathe out and breathe in? 2

[1] **Sample answer:** They stay in my lungs until I breathe out.

[2] **Sample answer:** A muscle helps move air in and out of my lungs.

Sample answers for "For You to Think About": No. Whales take in oxygen out of the air through a blowhole on the top of their head. Fish take oxygen out of the water through their gills.

Suggested activity and research: After discussing "Breathing out," you may wish to involve the pupils in an activity which would help them discover more about expiration. Have the pupils hold a mirror close to their nose and mouth. The pupils will most likely observe that the mirror becomes cloudy as they breathe out. You might then have the pupils look in reference books under the heading *respiratory system* to find out why the mirror becomes cloudy as they breathe out and why this is important.

FINDING OUT

How can you find out if the air you breathe in is different from the air you breathe out?

You will need: limewater (from a drugstore), 2 wide-mouthed jars, 2 balloons, string, air pump such as bicycle tire pump or ball pump

- Pour limewater into the jars until they are half full.
- Fill a balloon with air from the pump.
- When the balloon is filled with air, wrap the string around it as shown.
- Mark the string so that you know how big the balloon is.
- Put the opening of the balloon into the limewater in one jar. Slowly let the air out of the balloon into the water.

What happened to the water?

- Fill the other balloon with air from your lungs.
- Use the string to make sure that this balloon is the same size as the first balloon.
- Put the opening of the second balloon into the limewater in the other jar. Slowly let the air out of this balloon.

Was the air in the second balloon different from the air in the first balloon? If so, how do you know? Why do you think the air was different?

Teaching helps for "Finding Out":

Processes used: observing, comparing, inferring.

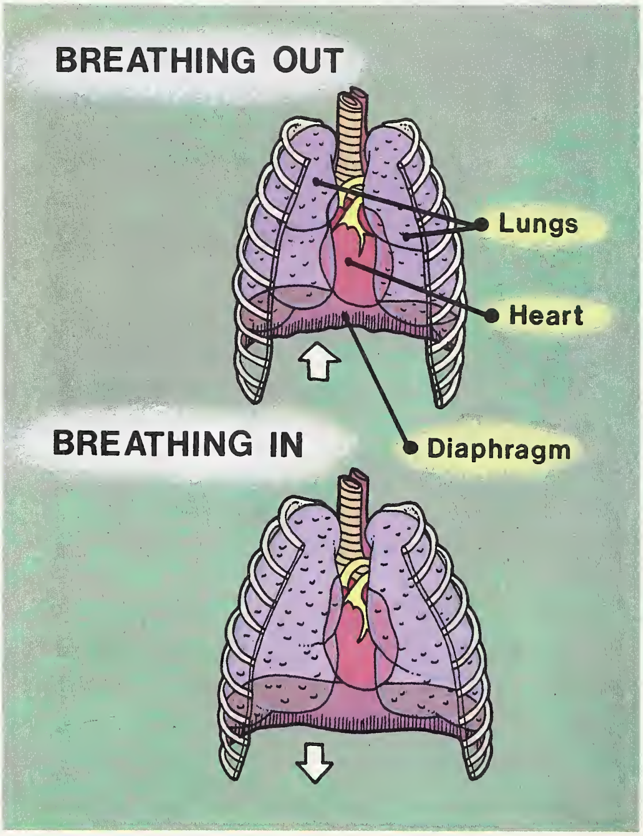
Sample findings: After the pupils let the air from the pump out into the water, they will most likely observe that nothing happened to the water. After they let the air from their lungs out into the water, the pupils will most likely observe that the water is cloudy. From this, the pupils may infer that the air from their lungs is different from the air around them.

Additional information: Limewater becomes cloudy when it comes in contact with carbon dioxide but remains unchanged when in contact with oxygen. The air from the pupils' lungs has a higher concentration of carbon dioxide than normal air.

How you breathe. Along with the parts of your respiratory system already given, there is still another important part. That part is a muscle called your *diaphragm* [DY-uh-FRAM].

Your diaphragm is found below your lungs. When this muscle relaxes, it moves toward your lungs. This helps push air out of your lungs. What do you think happens when your diaphragm is tightened?[1]

[1] **Sample answer:** It moves away from my lungs, allowing air to fill up my lungs.



FINDING OUT

How can you show how you breathe?

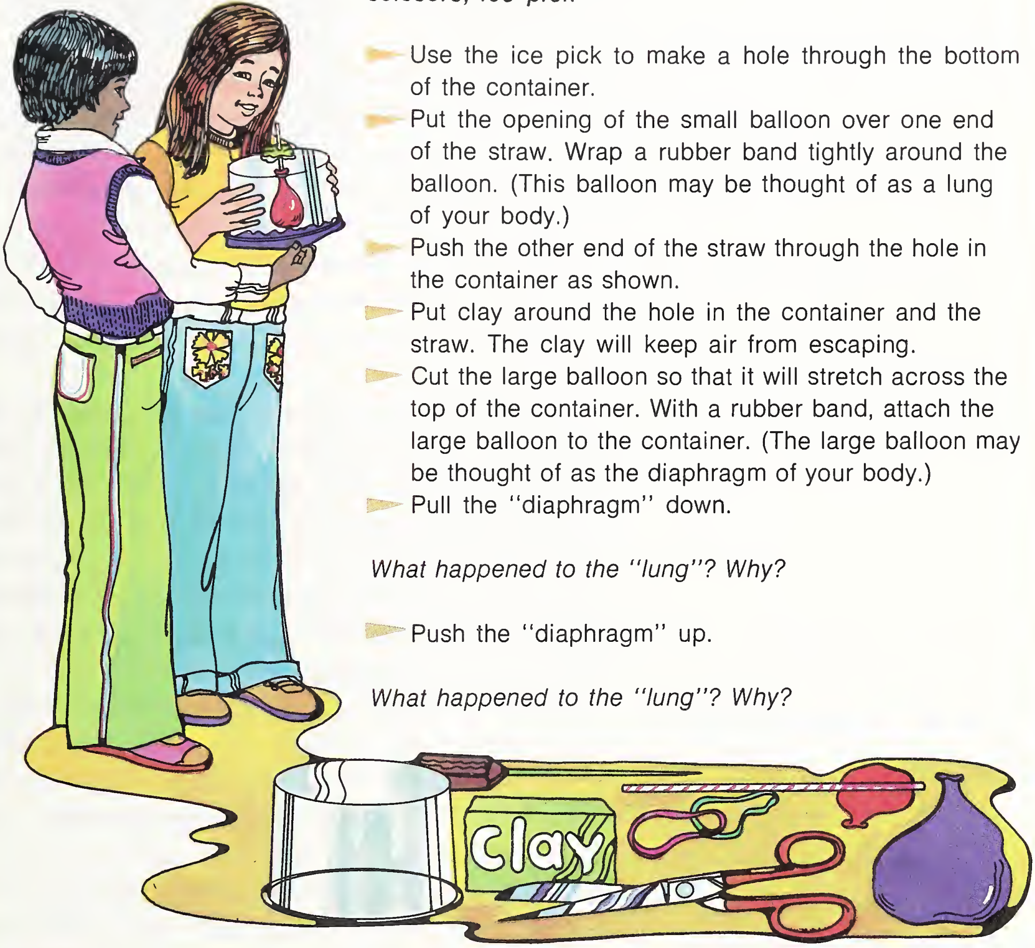
You will need: clear plastic container, clay, plastic straw, small balloon, large balloon, rubber bands, scissors, ice pick

- Use the ice pick to make a hole through the bottom of the container.
- Put the opening of the small balloon over one end of the straw. Wrap a rubber band tightly around the balloon. (This balloon may be thought of as a lung of your body.)
- Push the other end of the straw through the hole in the container as shown.
- Put clay around the hole in the container and the straw. The clay will keep air from escaping.
- Cut the large balloon so that it will stretch across the top of the container. With a rubber band, attach the large balloon to the container. (The large balloon may be thought of as the diaphragm of your body.)
- Pull the "diaphragm" down.

What happened to the "lung"? Why?

- Push the "diaphragm" up.

What happened to the "lung"? Why?



Teaching helps for "Finding Out":
Processes used: observing, comparing, inferring. *Sample findings:* As the pupils pull the "diaphragm" down, they may observe the "lung" swell with air. They may infer that when the "diaphragm" moves down, it makes the space in the container larger, causing the "lung" to pull in air. When the pupils push the "diaphragm" up, they may find that the "lung" empties. They may then infer that the "lung" empties when the "diaphragm" moves, because the space in the container becomes smaller and air is pushed out. *Extending the "Finding Out":* At this time, you may wish to have the pupils find out more about breathing. Have the pupils feel their ribs as they breathe. Then you might want to ask them this question: Why is it important that your ribs move as you breathe? (Sample answer: So that the space around my lungs changes and air gets into or out of my lungs.)

Your digestive system

Along with oxygen, the cells of your body need food. Without food, systems such as your circulatory and respiratory systems cannot do their jobs. To get the food they need, your systems depend mostly on one system. That system is your *digestive system.* How do you think your digestive system helps the systems of your body get food?[1]

Your mouth. Stop for a moment and think about the foods you eat. You most likely eat many different foods. But the cells of your body cannot use most of these foods as they are when you put them in your *mouth.* The foods you eat must be broken down before your cells can use them. Breaking down foods is one of the jobs of your digestive system. This job begins when you put food in your mouth. How are foods broken down in your mouth?[2]

Several things happen once food is in your mouth. Perhaps the first thing that happens is that you chew the food with your teeth. When you chew food, your teeth help break it apart. They also help mix the food with *saliva* [suh-LY-vuh]. Saliva is a liquid. This liquid is given off into your mouth by organs called *salivary* [SAL-uh-VEHR-ee] *glands.* What other parts of your mouth might help mix food with saliva?[3]

Saliva is important for two main reasons. One of these reasons is that it helps break down certain foods. Saliva also makes food wet. Why do you think it is important that food becomes wet in your mouth?[4]

Your esophagus and stomach. Once you have mixed food and saliva, you swallow the food. When you swallow, the muscles of your tongue push the food into

For You to Think About

Do you think it is better to chew your food many times or a few times? Why?

[1] **Sample answer:** My digestive system breaks down my food so that my other systems can use it.

[2] **Sample answer:** By chewing and by saliva.

[3] **Sample answer:** My tongue and the roof of my mouth.

[4] **Sample answer:** It is important because it makes swallowing easier.

Sample answer for "For You to Think About": Many times, because more chewing breaks down food more. When the food is in very fine pieces, it is easier for saliva in the mouth and juices in the stomach to break it down.

FINDING OUT

Can you swallow food while standing on your head?

You will need: some food such as crackers or cookies

- Stand on your head.
- Have someone put some food in your mouth.
- Chew the food. Then swallow it.

What happened to the food after you swallowed it? Why?

your throat. From your throat, the food passes into a long tube. This tube is known as your *esophagus* [ih-SOF-uh-guhs]. The walls of your esophagus are made up of muscles. These muscles push the food toward your *stomach.*

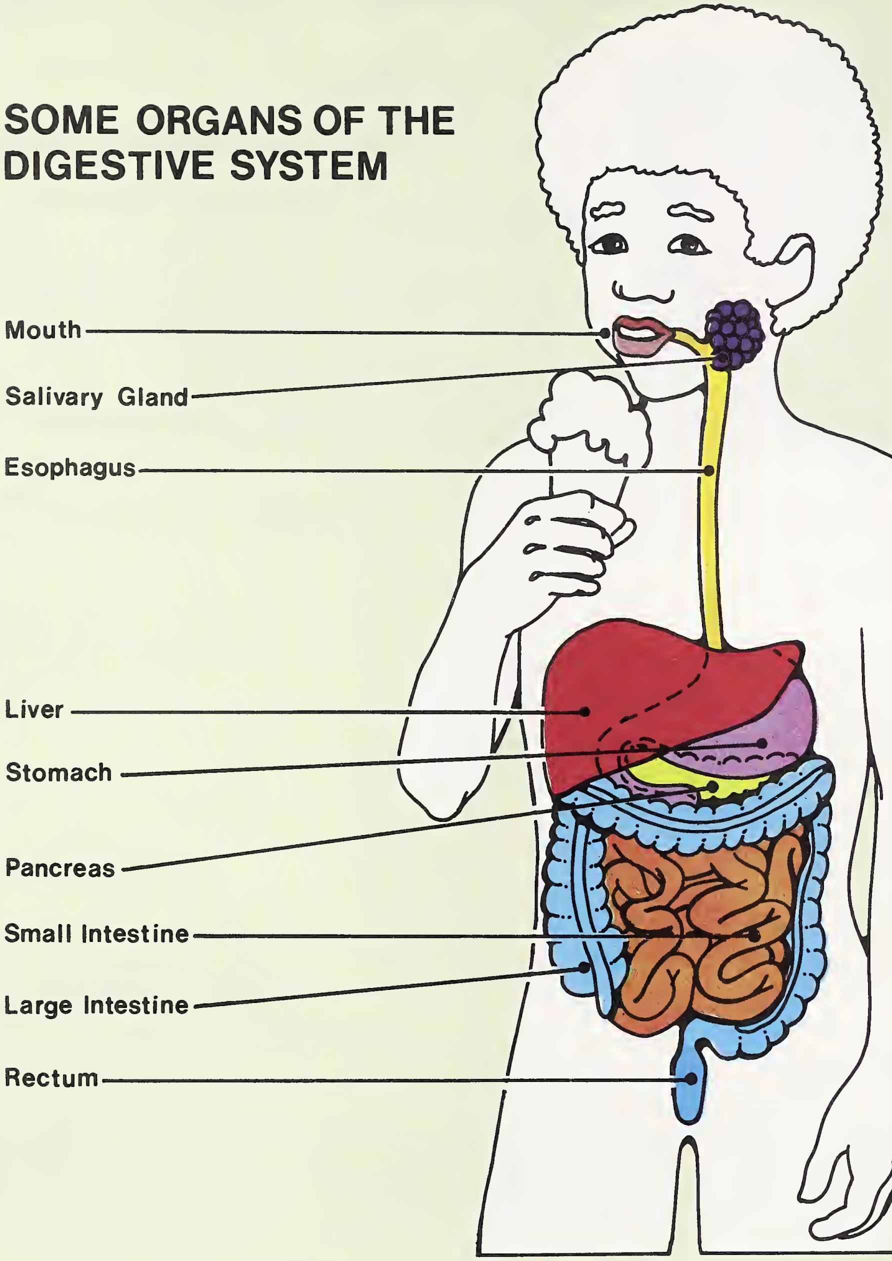
Food stays in your stomach for about four hours. During this time, juices from the walls of your stomach break down the food into a thick liquid. Why do you think it is important that food is broken down into a liquid?[1]

Your small intestine. Though the food is in your stomach for several hours, the food is still not ready to be used by your cells. The food must be broken down still further. This breaking down takes place in another organ known as your *small intestine.*

[1] **Sample answer:** Because the liquid is easier to pass into the blood than solid food would be.

Teaching helps for "Finding Out":
Processes used: observing, inferring.
Sample findings: After swallowing the food, the pupils will find that the food does not come back into their mouth. They may infer that the muscles in their esophagus keep the food moving toward their stomach.
Extending the "Finding Out": At this time, you may wish to point out to the pupils that their throat leads to both their esophagus and their trachea. Then have the pupils find out what keeps food from being swallowed into their trachea. They may do this by looking in reference books under the heading *epiglottis*. Then have the pupils discuss their findings.

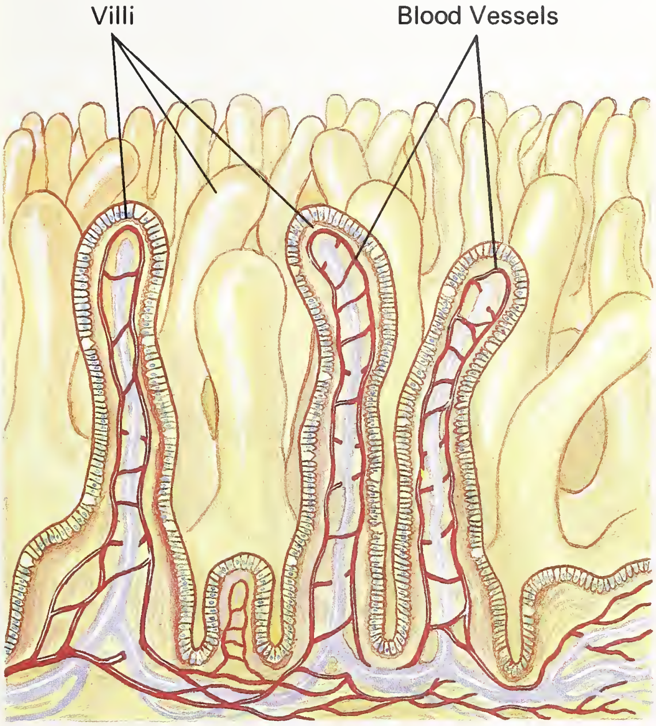
SOME ORGANS OF THE DIGESTIVE SYSTEM



Suggested discussion: You may wish to use the picture above as an aid in teaching the pupils about what happens to food after it is put into their mouth. First, have the pupils read the material about the parts of the digestive system on pages 70–71 and 73–74. Then have the pupils use the picture to trace the path of food as it travels through the digestive system.

While the food is in your small intestine, it is broken down by more juices. These juices are given off into your small intestine by two organs. One of these organs is your *liver*. The other organ is your *pancreas* [PANG-kree-uhs].

After the juices from your liver and pancreas have broken down the food, parts of it are ready to be used by your cells. But these parts must first pass through the walls of your small intestine. These walls are covered with millions of tiny, fingerlike parts. These parts, called *villi* [VIHL-EYE], have very thin walls. In fact,



the walls of your villi are only about one cell thick. Inside your villi are some blood vessels. These blood vessels pick up food as it passes through the walls of your villi. Why is it important that your small intestine has so many villi? [1]

Your large intestine. Though much of the food you eat can be used by your cells, some parts of it cannot be used. These parts are wastes. These wastes leave your small intestine. But they do not pass into your blood. From your small intestine, wastes enter another organ of your digestive system. This organ is your *large intestine.*

Wastes gather in your large intestine until they are ready to be passed out of your body. Before these wastes leave your body, they lose water. This water passes from the wastes into your blood. Finally, these wastes are passed out of your body. Do you think it is important that wastes are passed out of your body? Why or why not? [2]

A Second Look

1. What are some organs of your circulatory system, and what are their jobs?
2. Why is your respiratory system important?
3. What are some organs of your digestive system, and what are their jobs?
4. How does your digestive system help the other systems of your body?

[1] **Sample answer:** It makes the surface of the small intestine larger so that more food can pass from the small intestine into the blood.

[2] **Sample answers:** Yes. Because wastes cannot be used by my body and might be harmful to me if they are not passed out of my body.

Suggested research: After discussing "Your large intestine," you may wish to point out that the appendix is attached to the large intestine and may cause a problem for some people. You may then want to have the pupils find out more about the appendix. They may do this by looking in reference books under the headings *appendix* and *appendicitis.*

Sample answers for "A Second Look": 1. Your heart moves blood to all parts of your body. Your blood vessels carry your blood to and from all parts of your body. 2. Your respiratory system is important because it takes oxygen into your body to be used by your cells. 3. Your stomach is an organ in which food is broken down into a thick liquid. Juices in your small intestine help break down the food further. Your large intestine holds wastes which cannot be used by your body. 4. Your digestive system breaks down food so that it can be used by all the cells of your body.

3 How can you help your body work properly?

As you may have noticed, most of your systems work without your having to think about them. Actually, almost every part of your body works without your having to think about it. But there are some things you can do to help your body work properly. What might these things be? [1]What do you do to help your body work properly?

[1] **Sample answer:** Get enough rest and exercise, eat proper foods, visit a doctor regularly.

Main concepts of the chapter (pages 75–91):

Eating properly and getting enough exercise are ways you can help make sure your body is working properly.

Getting enough rest and visiting a doctor for a checkup at least once a year are ways you can help make sure your body is working properly.

Performance objective: After studying the information provided in this chapter, the pupils should be able to

—list the things they can do to help make sure their body is working properly.

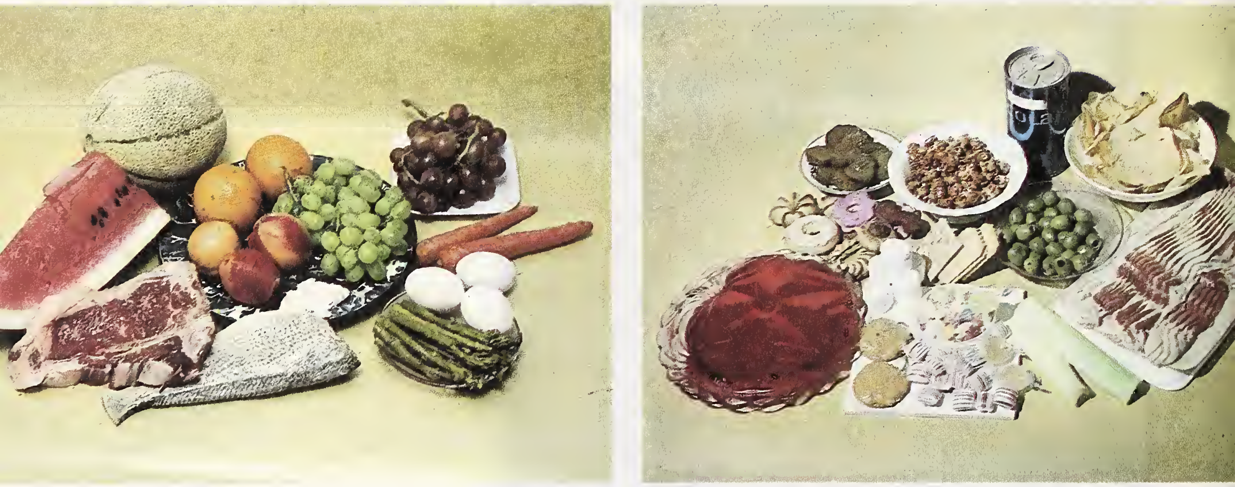
Important words: nutrients, fats, energy, carbohydrates, proteins, minerals, vitamins.

Choosing to eat properly

If you could plan your own meals, what foods would you choose to eat? Hamburgers and French fries? Candy and soft drinks? These are the foods that some people would choose to eat at every meal if they could. Do you think these people would be helping their body work properly? Why or why not?[1]

It has been found that the kind of food you eat is important in helping your body work properly. Some kinds of food are more helpful to your body than others. The foods that are most helpful are made up of many *nutrients* [N(Y)OO-tree-uhnts]. Nutrients are the parts of foods that your cells use. The pictures below show some foods made up of a large amount of nutrients and some foods made up of a small amount of nutrients. What are some other foods that might have a large amount of nutrients?[2] What are some other foods that might have a small amount of nutrients?[3]

The foods on the left have a large amount of nutrients. Those on the right have a small amount of nutrients.



[1] **Sample answers:** No. Because without eating other kinds of foods, these people would not give their body enough of the kinds of foods it needs to work properly.

[2] **Sample answer:** Butter, milk, tomatoes.

[3] **Sample answer:** Ginger ale, popcorn, graham crackers.

Fats. In order to work properly, your body needs many different nutrients. These nutrients are grouped into several main kinds. One of these kinds is called *fats.* Fats are needed by your cells for *energy.* Energy is power needed to do things such as grow, think, and run. What might you feel like if you did not eat foods that are made up of some fats? [1]

[1] **Sample answer:** Tired.

Some of the fats you eat may not be used by your cells right away. These fats are stored in your body. One place fats are stored is under your skin. Fats may also be stored around organs such as your heart and liver.

FINDING OUT

How can you show which foods are made up of a large amount of fat?

You will need: small pieces of foods such as bacon, cheese, peanuts, margarine, apple, raisins, lettuce; brown paper bag

- Spread the bag so that it lies flat.
- Write the name of each food on the bag.
- Rub each piece of food next to its name.
- Hold the bag up to a light. The foods made up of a large amount of fat will leave a greasy spot on the paper.

Which of the foods are made up of a large amount of fat? Try testing other foods for fat.

Teaching helps for "Finding Out":
Processes used: observing, comparing, inferring.
Sample findings: The pupils will most likely observe that the bacon, peanuts, margarine, and cheese leave a greasy spot on the paper. From this, the pupils may infer that these foods are made up of a large amount of fat.

Having some stored fats is helpful to your body. Stored fats are always ready to help give your cells energy. These fats are also helpful in other ways. Fats stored under your skin help keep your body warm. Fats stored around your organs help protect these organs. How do you think stored fats protect your organs? 1

Generally, you only need to eat a few foods made up of a large amount of fat each day. Some of these foods are butter, cream, hot dogs, egg yolk, oil, nuts, pork and chocolate. Which of these foods do you eat?

Exploring on Your Own

Some people feel that too many stored fats are not helpful to people. See if you can find out why this might be so.

[1] **Sample answer:** These fats act as a cushion to guard the organs from being injured when bumped.

Carbohydrates. There is another kind of nutrient that your cells need for energy. This kind is known as *carbohydrates* [KAHR-boh-HY-DRAYTS]. You need to take in about twice as many carbohydrates as fats to get the same amount of energy. Some foods that are made up of large amounts of carbohydrates are cereals, fruits, and breads.

Most kinds of nutrients must be broken down before your cells can use them. But, some carbohydrates can be used by your cells in the form in which they enter your mouth. These carbohydrates are found in foods such as fruits and honey. When might these carbohydrates be very helpful to your body? Why? 2

[2] **Sample answer:** When I have been exercising for a long time, my body might need energy right away.

The foods shown here will give these people some of the fats and carbohydrates their body needs. Would you eat any other kinds of foods with this meal? If so, why?

Sample answer for "Exploring on Your Own": These people feel that having too many stored fats, or being overweight, can lead to heart disease and other diseases.

Sample answer for the caption: Yes. Because I need other nutrients along with carbohydrates and fats to help my body work properly.

FINDING OUT

How can you show which foods are made up of a large amount of carbohydrates?

You will need: foods such as bread, potato, macaroni, boiled egg, cheese; iodine; waxed paper; spoon

- Crush each food on the waxed paper with the spoon.
- Put a drop of iodine on each food. Foods with a large amount of carbohydrates will turn blue-black.

Which foods have a large amount of carbohydrates? Try testing other foods for carbohydrates.

Proteins. Fats and carbohydrates are not the only kinds of nutrients that your cells need for energy. Another kind, called *proteins* [PROH-TEENZ], is needed for energy. However, proteins mostly help your cells in two other ways. One of these ways is by helping your cells grow. In fact, many parts of your body are made up of proteins. Your muscles and blood, for example, are made up of many proteins. Proteins also help repair injured cells. Why do you think it is important for injured cells to be repaired?[1]

Foods such as fish, eggs, and cheese are made up of a large amount of proteins. Which of these foods do you eat? Do you think you eat enough foods made up of a large amount of proteins to help your cells grow properly? Why or why not?[2]

[1] **Sample answer:** My body might not be able to make enough new cells to replace my injured cells.

[2] **Sample answers:** Yes. Because my body seems to be growing properly.

Teaching helps for "Finding Out":
Processes used: observing, comparing, inferring. *Sample findings:* After putting iodine on each food, the pupils will most likely observe that the bread, potato, and macaroni turn blue-black From this, the pupils may infer that these foods have a large amount of carbohydrates.

What kind of nutritional value does each kind of food these children are eating have?

Sample answers for the caption: Cotton candy has mostly carbohydrates, with few nutrients. Cereals and bread have mostly carbohydrates, which give energy, and minerals, which are needed by many parts of the body. Hot dogs and bacon have mostly fats, which give energy, and proteins, which help cells grow. Ice cream has fats and carbohydrates. Orange juice has vitamins, which help the body do many of its jobs. Milk has mostly vitamins, as well as carbohydrates and proteins, while eggs are a source of both vitamins and proteins.

CHOCOLATE MILK

Minerals. Still another kind of nutrient is called *minerals.* Like proteins, minerals make up many parts of your body. A mineral known as *iron* is found in every cell of your body. *Calcium* is a mineral that helps make up your bones and teeth.

Minerals also help direct certain activities of your body. One such activity is that of carrying oxygen by your blood. Another activity is that of moving your muscles. If you look at the table on page 83, you can see the name of some minerals and some of the foods that have these minerals.

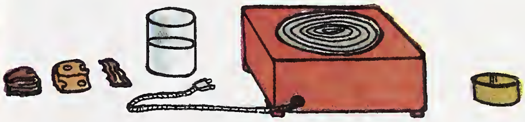
FINDING OUT

How can you show which foods are made up of a large amount of minerals?

You will need: foods such as cheese, meat, milk; tin can; hot plate; knife

- Put a small piece of cheese into the can.
- Heat the can until the cheese turns to gray ashes. The ashes are minerals from the cheese.
- Heat the other foods.

What happened to these foods? Which of these foods are made up of a large amount of minerals? Try testing other foods for minerals.



Teaching helps for "Finding Out":
Processes used: observing, comparing, inferring.
Sample findings: After heating the meat and milk, the pupils will most likely observe that these foods turn to gray ashes. From this, the pupils may infer that these foods are made up of a large amount of minerals.

Some Minerals Found in Foods

Mineral	Foods high in this mineral
Calcium	Milk, cheese
Copper	Liver, nuts, fruits
Iodine	Seafoods, iodized salt
Iron	Liver, raisins, beans
Magnesium	Cereals, meat
Phosphorus	Milk, vegetables
Sodium	Meat, table salt
Sulphur	Eggs, nuts, meat

Vitamins. Perhaps the most important kind of nutrient is called *vitamins*. This kind of nutrient helps the other nutrients do their jobs. Vitamins also help your body do many of its jobs. For instance, vitamins help your heart, nerves, and stomach work properly. Still another thing vitamins do is help your cells grow.

The table on page 84 shows the name of some vitamins and some of the foods that have these vitamins. Which of these foods do you eat? How might you know if you get enough vitamins? [1]

[1] **Sample answer:** By having a checkup by a doctor and making sure I eat enough foods with a large amount of vitamins.

For You to Think About

Why do you think many people feel that they need to take vitamin pills?

Suggested research and discussion: After discussing "Vitamins," you may wish to involve the pupils in an activity that would help them discover the nutritive values of some foods. Have the pupils bring to school and read some labels from some different foods. Then you might want to ask the pupils these questions: Why do you think these food labels are important? (Sample answer: Because people can read them and try to plan meals which will give the people the nutrients they need.) What do you think the words "enriched" and "fortified" mean on a food label? (Sample answer: That nutrients have been added to the food.)

Sample answer for "For You to Think About": Advertisements often lead people to believe that they are not getting enough vitamins from their meals.

Some Vitamins Found in Foods

Vitamin	Foods high in this vitamin
A	Butter, milk, green and yellow vegetables
B_1	Liver, pork, milk, beans
B_2	Liver, milk, eggs, green leafy vegetables
C	Oranges, tomatoes, broccoli, cantaloupes
D	Milk, egg yolks, butter
K	Leafy vegetables, liver
Niacin	Fish, cereals, green vegetables

Four food groups. Foods are often grouped according to the nutrients they are mostly made up of. There are four chief groups of foods. These groups are called the *milk group*, the *bread-cereal group*, the *vegetable-fruit group*, and the *meat group*.

Eating some foods from these groups every day helps your body have the nutrients it needs. The table on the next page may help you to know if you are eating properly.

Exploring on Your Own

Make a list of the foods you eat during a week. Check the Daily Food Guide on page 85 to see if you are eating properly.

Suggested research: After discussing "Vitamins" on pages 83 and 84, you may wish to have the pupils find out what might happen if someone did not get enough of a certain vitamin. The pupils might do this by looking in reference books under the headings *beriberi, pellagra, rickets, scurvy,* and *vitamins.*

Daily Food Guide

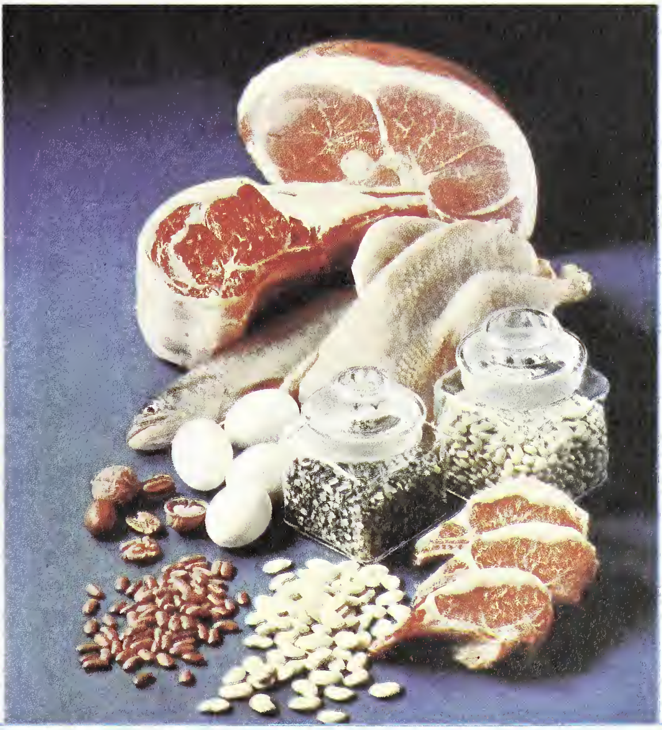
Food Group	Serving for Children	Serving for Teenagers	Examples of a Serving
Meat group and alternate proteins	2 servings	3 servings	60-90 g lean, cooked meat or 60 ml peanut butter or 250 ml dried beans, peas, etc. or 2 eggs or 60 g cheese or 80 - 250 ml nuts
Vegetable and fruit group	4 - 5 servings	4 - 5 servings	125 ml raw or cooked vegetables, fruits or their juices. Include at least 2 vegetables.
Bread and cereal group	3 - 5 servings	3 - 5 servings	3 pieces of bread (preferably whole, enriched bread) or 125 - 250 ml cereal or 125 - 180 ml rice or pasta
Milk group	2 - 3 servings	3 - 4 servings	250 ml milk, yogurt or cottage cheese or 45 g cheese.

Milk Group

Bread-cereal Group

Suggested discussion: After discussing the sections on the nutrients and the four food groups, you might want to point out to the pupils that many people consider water and oxygen as nutrients along with those nutrients discussed. You might then want to ask the pupils this question: Why do you think many people consider water and oxygen as nutrients? (Sample answer: Because water and oxygen are important to the cells of the body since, like the nutrients discussed, they supply the cells material needed to do certain jobs.)

Vegetable-fruit Group


Meat Group

Choosing to get enough rest

Choosing to eat properly is not the only thing you can do to help your body work properly. Another thing you can do is rest. When you rest, the cells of your body rest. Your cells need to rest so that they can grow and work. How much rest do you get each day?[1] How do you rest?[2]

People rest in many ways. For instance, people who have been walking or standing may rest by sitting down. Of course, people probably get the most rest by sleeping. How much sleep do you get each day?[3] How much sleep do other people in your family get?[4]

You may have noticed that everyone in your family does not get the same amount of sleep. The reason

[1] **Sample answer:** 12 hours.

[2] **Sample answer:** By sleeping and sitting down.

[3] **Sample answer:** 11 hours.

[4] **Sample answer:** My parents get 8 hours. My brother and sister get 10 hours.

for this is everyone does not need the same amount of sleep. Usually, the amount of sleep people need depends on the rate they are growing. The amount may also depend on how healthy they are. What else might the amount of sleep a person needs depend on? [1]

Choosing to get enough exercise

Along with eating properly and getting enough rest, getting enough exercise is a way to help your body work properly. Exercise is a way of using your body. When you run or walk, you exercise. When you play games, such as softball and tennis, you exercise. What are some other ways you know of to exercise? [2]

Exercise helps your body in several ways. For example, exercise helps your muscles become stronger. Strong muscles do not become injured easily. Exercise also helps you look and feel good. How often do you exercise?[3] Do you think it is better to exercise a little every day or a lot once a month? Why? [4]

Choosing to have checkups

Still another way to be sure your body is working properly is to visit a doctor for a checkup at least once a year. During a checkup, a doctor may listen to your heart and lungs. A doctor may also look at your ears and throat. What else might a doctor do during a checkup?[5] Why?

Why do you think it is important that a doctor check to see that your body is growing and working properly? [6]

[1] **Sample answer:** Age.

[2] **Sample answer:** Skiing and playing football.

[3] **Sample answer:** Every day.

[4] **Sample answers:** A little every day. Because muscles that are not used often are weaker, have to work harder, and do not do as well as muscles that are used often.

[5] **Sample answer:** Check my height and weight.

[6] **Sample answer:** After checking these things, the doctor may find a problem with them and help correct it.

Suggested activity: After discussing the material on pages 88 and 89, you may wish to involve the pupils in an activity which would help them become aware of ways they can help their body work properly. Have the pupils keep a list of things they do to help their body work properly. Have them compare their list with those of others in their class.

In what ways might the things which are happening in the pictures on this page and the next be helpful to the children?

Sample answers for the caption: Exercising might help the children's muscles to be strong and help the children look and feel good. Going to a doctor for a checkup might help the children make sure their body is free from germs or other problems.

A Second Look

1. What are the main kinds of nutrients? Why are they important?
2. Why is it important for you to eat foods from each of the four food groups?
3. How might rest and exercise help your body work properly?
4. Why is a visit to a doctor for a checkup important?

Sample answers for "A Second Look": 1. Fats are important because they give your cells energy. Carbohydrates are important because they give your cells energy. Proteins are important mostly because they help your cells grow. Minerals are important because they help make up many parts of your body and help direct certain activities of your body. Vitamins are important because they help other nutrients do their job. 2. It is important for me to eat foods from each of the four food groups because this helps make sure my body has the nutrients it needs. 3. Rest may help the cells of my body grow and work as they should. Exercise might help my muscles become stronger and help me look and feel good. 4. A visit to a doctor is important because a doctor can check to see that my body is working properly.

Workers Who Use Science

Learning about nutrients and the four food groups may help you eat properly. There are many people who learn about these things for another reason. That is, knowing about nutrients and the food groups helps these people in doing their job. Some of these people are called *dietitians* [DY-uh-TIHSH-uhnz].

Dietitians often plan meals for many other people. For example, many dietitians plan meals for people who are in hospitals. Other dietitians plan meals for people in schools.

Along with planning meals, dietitians do other things. Dietitians may buy food and cooking equipment for hospitals and schools. Some dietitians also train people to cook food properly. Still other dietitians teach people about nutrients and the four food groups.

In addition to working in hospitals and schools, many dietitians work in restaurants. Some dietitians work for companies that prepare and sell food.

To find out more about dietitians, try to find answers to these questions:

What do dietitians who work for companies that prepare and sell food do? [1]

What kinds of cooking equipment do some dietitians need to buy for hospitals? [2]

Along with sources of your own, writing to the following source may help you: The Canadian Dietetic Association, 1393 Yonge Street, Toronto, Ontario M4T 1Y4.

This dietitian is checking food prepared in a hospital. Why do you think it is important that the food is checked?

Sample answers for "Workers Who Use Science":
[1] Give the company information on the nutrients in its products, make up recipes, keep test kitchens working properly.
[2] Stove, refrigerator, pots, pans.

Sample answer for the caption: To see that the food is cooked properly and that there is nothing in the food that might cause disease or otherwise harm the body.

Reviewing the Main Ideas

Most living things are made up of cells.
Cells of the same kind often join and work together as a tissue.
The four main groups of tissues in your body are connective tissue, epithelial tissue, muscle tissue, and nerve tissue.
Organs are made up of tissues with much the same jobs.
Organs working with other organs make up a system.
The systems of your body depend on each other to do their jobs.
Your circulatory system carries things to and from your cells.
Your respiratory system takes oxygen into your body. Carbon dioxide passes out of your body through this system.
Your digestive system breaks down foods so that they may be used by your cells.
Eating properly, getting enough rest, getting enough exercise, and visiting a doctor at least once a year are ways you can help make sure your body is working properly.

Reading About Science

Asimov, Isaac. *How Did We Find Out About Vitamins?* Pickering, Ontario: Beaverbooks, 1974.
Gallant, Roy A. *Me and My Bones.* Toronto, Ontario: Doubleday Canada Limited, 1971.
Jones, Hettie. *How to Eat Your ABC's: A Book about Vitamins.* Richmond Hill, Ontario: Scholastic-TAB Publications Ltd., 1976.
Schuman, Benjamin N. *The Human Skeleton.* Toronto, Ontario: McClelland and Stewart Limited, 1971.

Reviewing the unit: You may wish to have the pupils study "Reviewing the Main Ideas" to help prepare for "Testing for Understanding" on page 94.

For further reading: You may wish to encourage the pupils to read the books listed under "Reading About Science" and other books and articles related to the topic of the body. Such articles might be found in reference books under the headings *nervous system*, *skeletal system*, and *fad diets.*

Testing for Understanding

Ideas to Check

On your paper write *T* for each sentence below that is true. Write *F* for each sentence that is false.

T 1. Your circulatory system carries oxygen to your cells.
T 2. The walls of your capillaries are only about one cell thick.
T 3. Having some stored fats is helpful to your body.
F 4. The body of most living things is made up of about the same number of cells.
F 5. The cells of your body depend only upon your digestive system to get the food they need.

Write on your paper the word or words that best fit in each blank below. Choose from these words: *oxygen, energy, saliva, arteries, veins, nutrients, tissues, organs.*

1. Cells of the same kind that join and work together form ____.
2. ____ is a liquid that helps break down some foods while they are in your mouth.
3. Your cells need fats, carbohydrates, and proteins for ____.
4. ____ are the parts of foods that your cells use.
5. The blood vessels that carry blood away from your heart are called ____.
6. ____ are parts of your body that are formed by tissues working together.

Words to Use

tissues
saliva
energy
nutrients
arteries
organs

Suggestions for evaluation: You may wish to use the test questions provided under "Testing for Understanding" to evaluate the pupils' understanding of the main ideas and important words of this unit. Additional test questions for the unit "Your Body" are provided for you on page T17 of the Teacher's Manual. These test questions may be duplicated for classroom use. Answers to these additional test questions can be found on page T22 of the Teacher's Manual.

Having Fun with Science

Fact or Fantasy?

There are many statements about eating properly that many people believe. A few of these statements are given below. Which do you think are true? The answers are also given below.

1. Eating an apple cleans your teeth as well as brushing does.
2. If a few vitamins are good for you, many vitamins are even better.
3. Eating onions cures a cold.
4. Foods that have many proteins are fattening.

Word-clue Game

On a piece of paper write the missing letters of the word about your body that best fits each definition below.

P _ _ _ _ _	yellow fluid of your blood
_ R _ _ _ _ _	tube to your lungs
O _ _ _ _ _	gas used by most cells
_ _ _ _ T	organ that makes blood move
E _ _ _ _ _ _ _ _	tube to your stomach
_ _ _ I _ _	liquid in your mouth
N _ _ _ _ _ _ _ _	parts of foods that cells use

Things to Do

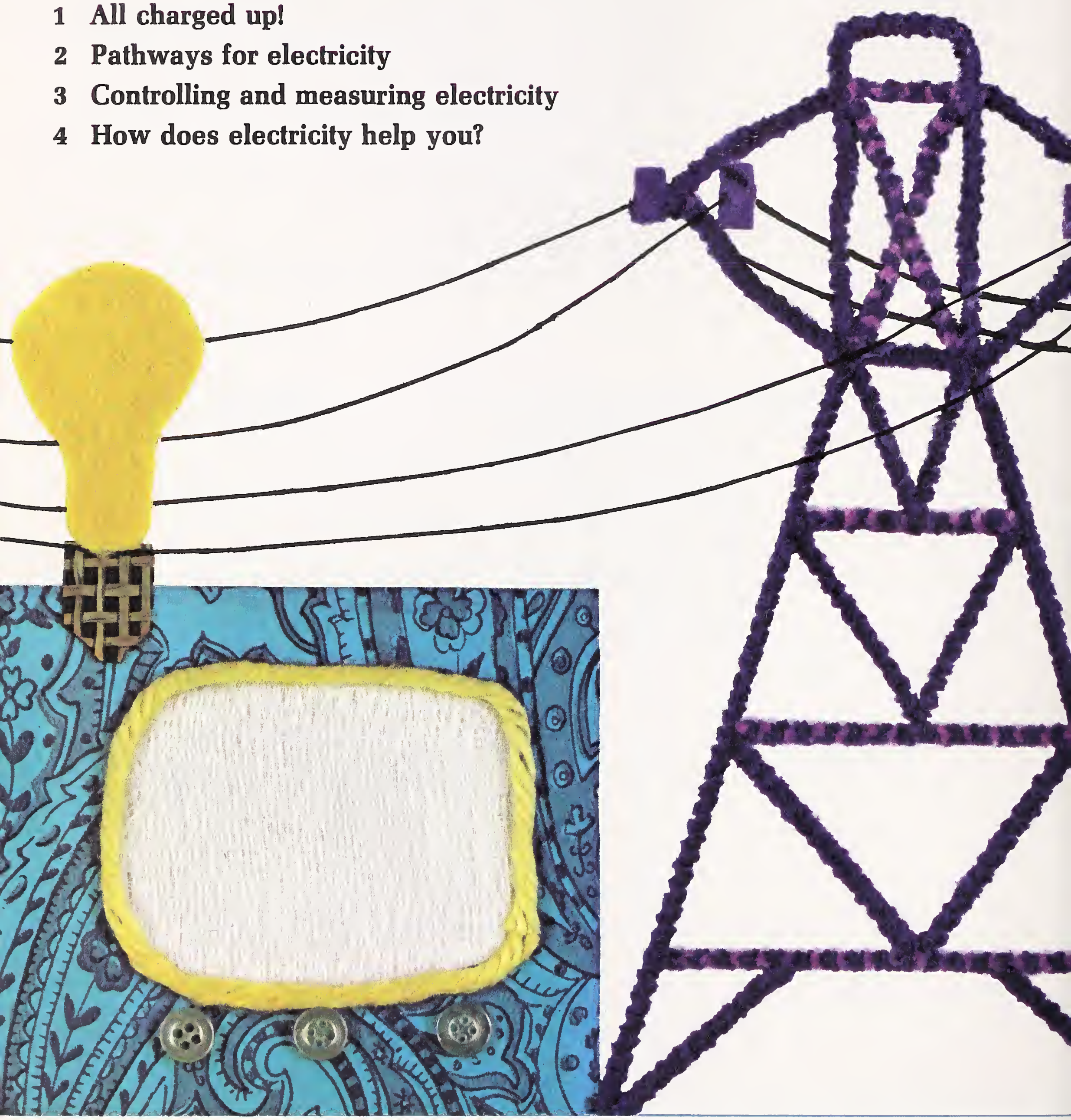
1. When people try to lose weight, they count *kilojoules*. See if you can find out what *kilojoules* are and why people count them when trying to lose weight.
2. Plan some meals that you think would help your body work properly.

Answers to Fact or Fantasy
1. False 2. False 3. False 4. True

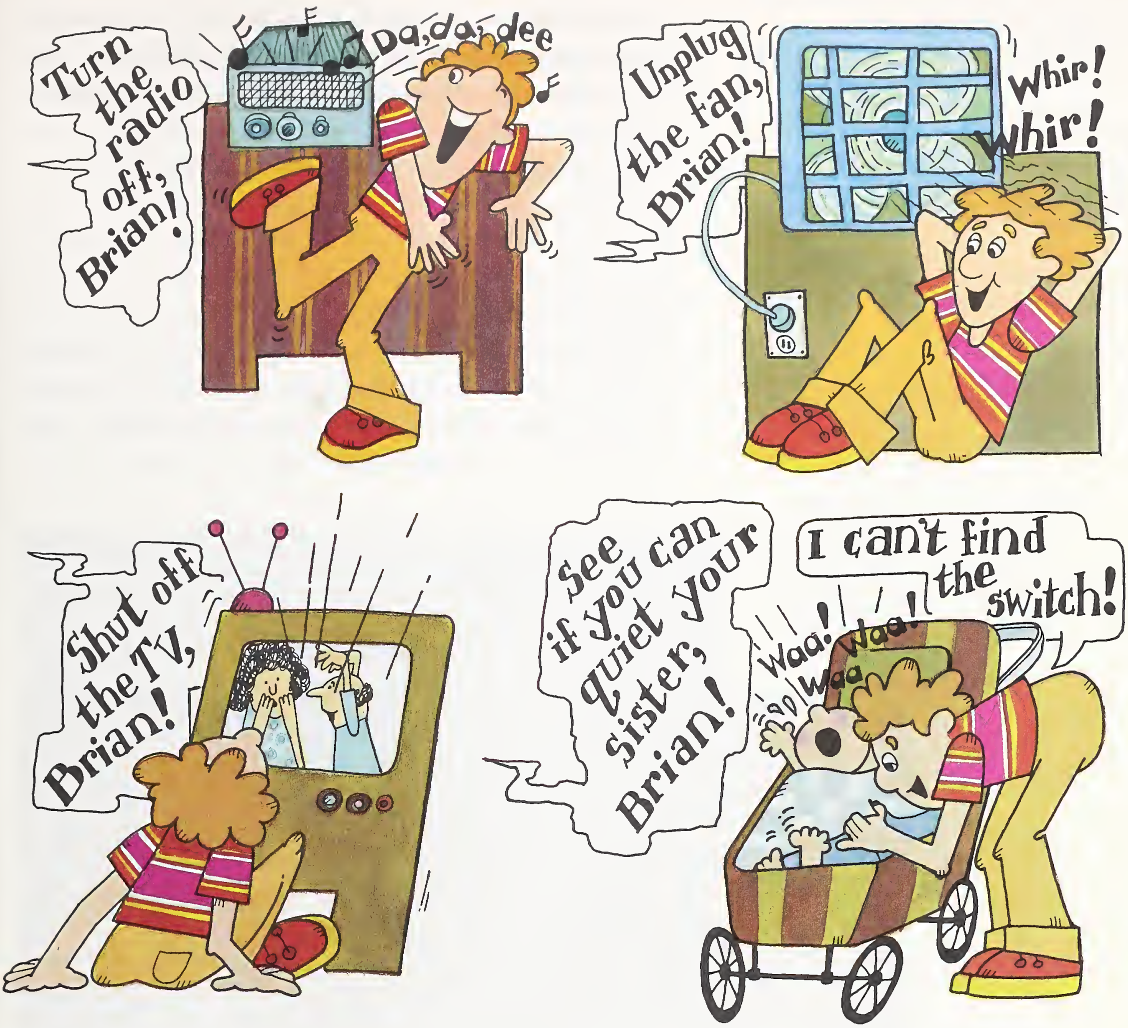
For further involvement: You may wish to use "Having Fun with Science" to involve the pupils in fun activities which reinforce some of the main concepts of the unit "Your Body." You may also wish to encourage the pupils to make up additional activities related to the topic of the body. **Answers for "Word-clue Game":** Plasma, trachea, oxygen, heart, esophagus, saliva, nutrients.

3 Electricity on the Move

1 All charged up!
2 Pathways for electricity
3 Controlling and measuring electricity
4 How does electricity help you?



Preparing for the unit: For a list of instructional materials helpful in teaching this unit, see page T13 of the Teacher's Manual. You may also wish to check the list of materials needed for each "Finding Out" activity in this unit and have the pupils begin collecting these materials. These activities are found on pages 100, 102, 107, 110, 113, 116, 120, 122, 129, and 130.


Turn the radio off, Brian!
Da, da, dee
Unplug the fan, Brian!
Whir! Whir!
Shut off the TV, Brian!
See if you can quiet your sister, Brian!
Waa! Waa! Waa!
I can't find the switch!

In what ways is Brian making use of electricity?[1]

How does electricity help you?[2]

Introducing the unit: You may wish to have the pupils read the cartoon above. Then have the pupils read the questions below the cartoon and discuss their answers to the questions.

Sample answers for questions below the cartoon:

[1] He's using electricity for the radio, the fan, and the television.

[2] It helps me to light lamps and run my radio.

1 All charged up!

[1] **Sample answer:** When combing my hair.

Have you ever taken off a woolen shirt in the dark? If so, you may have seen sparks coming from the shirt. The shirt may have stuck to you and even made a snapping sound as you tried to take it off. When else might you have noticed these things happen? [1]

Static charges

When you rub certain things together, you sometimes cause them to be charged with *electricity* [ih-LEHK-TRIHS-uht-ee]. This kind of electricity is called *static* [STAT-ihk] *electricity*. Static means not moving. Static

Lightning is a form of static electricity. Lightning is formed when clouds "rub" together very quickly. When have you seen lightning?

Main concepts of the chapter (pages 98–105):

Rubbing certain things together sometimes causes static electricity.

Electricity which moves along wires is current electricity.

Current electricity comes from batteries and power plants.

The machines that make electricity in a power plant are run by rushing water or by steam.

Performance objectives: After studying the information provided in this chapter, the pupils should be able to

—demonstrate how static electricity is made;

—name two sources of current electricity;

—name two things that are used to run the machines in electric-power plants.

Important words: static electricity, current electricity, batteries, power, energy, power plant.

Sample answer for the caption: During a thunderstorm in summer.

electricity most often stays where it is made. Combing your hair with a hard rubber comb may cause static electricity. This electricity may make your hair move toward the comb and even stick to it.

Think about the last time you rubbed an eraser across your desk. You probably saw many tiny pieces of rubber that you rubbed off the eraser. When you comb your hair with a hard rubber comb, you may rub off tiny particles from your hair onto the comb. But these particles are much too tiny to be seen. They are called *electrons* [ih-LEHK-TRONZ]. These electrons cause the comb to become charged with static electricity.

Suggested discussion: After discussing the last paragraph on this page, the pupils may question what electrons are. It would be sufficient to mention that electrons are tiny particles that are found in all things. Atomic structure will be discussed at the sixth-grade level. The concept of "negatively charged" or "positively charged" is also avoided. It is more important at this time that the pupils acquire a working knowledge of electricity and how electricity helps them.

Electricity is a kind of energy. You may feel this energy when you get a shock from static electricity. When have you felt a shock from static electricity?[1]

[1] **Sample answer:** When I walked on a rug and then touched a metal doorknob.

FINDING OUT

What are some things you can do with static electricity?

You will need: hard rubber comb, bits of paper, balloon, woolen sweater, fluorescent bulb, piece of nylon

This Finding Out works best on a day when the air is cool and dry.

- Comb your hair with the hard rubber comb. Bring the comb toward the bits of paper.

What happens to the bits of paper? Why?

- Rub a blown-up balloon on a woolen sweater. Put the balloon on the wall.

What causes the balloon to stick to the wall? What do you think would happen if you didn't rub the balloon on the sweater first? Try it.

- Rub the fluorescent bulb with the piece of nylon.

What causes the bulb to light up?

Teaching helps for "Finding Out":
Processes used: observing, inferring, communicating.
Sample findings: The pupils will most likely be able to pick up the bits of paper with the comb. The rubbing of the comb on the hair causes electrons from the hair to be rubbed onto the comb. When the comb gets extra electrons, it becomes charged with static electricity. The balloon becomes charged with static electricity when it is rubbed on the sweater. If the pupils don't rub the balloon on the sweater first, the balloon won't be charged with electricity. It won't stick to the wall unless it's first charged with electricity. Rubbing the fluorescent bulb charges it with static electricity and causes the phosphorescent paint inside the tube to glow momentarily. This is best seen in a dark room.

Moving charges

As explained, static electricity most often stays where it is made. But electricity can sometimes be made to move along wires. It is then called *current* [KUR-uhnt] *electricity*. Whenever you light a lamp or turn on the TV, you are using current electricity.

Current electricity is used to run the motor on this ride. What other things do you know of that are run by an electric motor?

Suggested discussion: After discussing the paragraph on this page, you may wish to emphasize that the nature of static electricity and of current electricity is the same. Where current electricity differs from static electricity is that in current electricity the charges are made to move along wires.

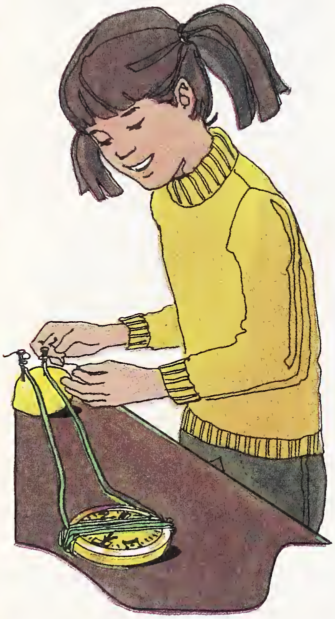
Sample answer for the caption: A vacuum cleaner, a beater, an electric can opener, and an electric drill.

While static electricity is made by rubbing, current electricity is made in other ways. What do you think are some ways that current electricity is made? [1]

From batteries. Have you ever used a flashlight or played a portable radio? If so, you may know that one way to get electricity is by using *batteries.* A battery has *power,* or energy, which causes electricity to light a bulb or play a radio. When else might you use this kind of battery?[2]

[1] **Sample answer:** With a battery and with machines in an electric-power plant.

[2] **Sample answer:** To run a toy.



FINDING OUT

How can you make a battery from a lemon?

You will need: compass, bell wire, galvanized nail and copper nail, lemon

- Wind about 20 turns of wire around the compass as shown. Leave the ends of the wire free.
- Connect one end of the wire to the galvanized nail.
- Connect the other end of the wire to the copper nail.
- Roll the lemon on the table, pushing down on it to break up some of the lemon's insides.
- Push the two nails through the lemon skin, making sure they do not touch.
- Watch the compass needle. If it moves, this means electricity is passing through the wire.

Do you think you can get enough electricity from a lemon to light a flashlight bulb? How might you find out?

Teaching helps for "Finding Out":
Processes used: observing, predicting, communicating.
Sample findings: A weak current is produced because of the chemical action of the acid in the lemon upon the two different metals. The pupils might try attaching the wires to a 1.5-volt socket with a 1.5-volt bulb in the place where the compass had previously been. They may get a very faint light for a few seconds.
Additional information: Rubbing the tips of the nails with sandpaper may help remove any impurities deterrent to the flow of electricity.
Extending the "Finding Out": At this time, pupils may wish to try other metals in the lemon to see if they can detect a current passing through the compass. They may wish to try a penny and a dime. They may also wish to try using two things made from the same metal.

Sometimes a car battery "runs down." To start the car, the battery might be hooked up to the battery of another car. How might this help start the car?

Besides the kind of battery used in flashlights and radios, there is another kind of battery. This is the kind used in a car to start the engine. These batteries have much more power than flashlight batteries. They also last much longer. Why do you think this is important?[1]

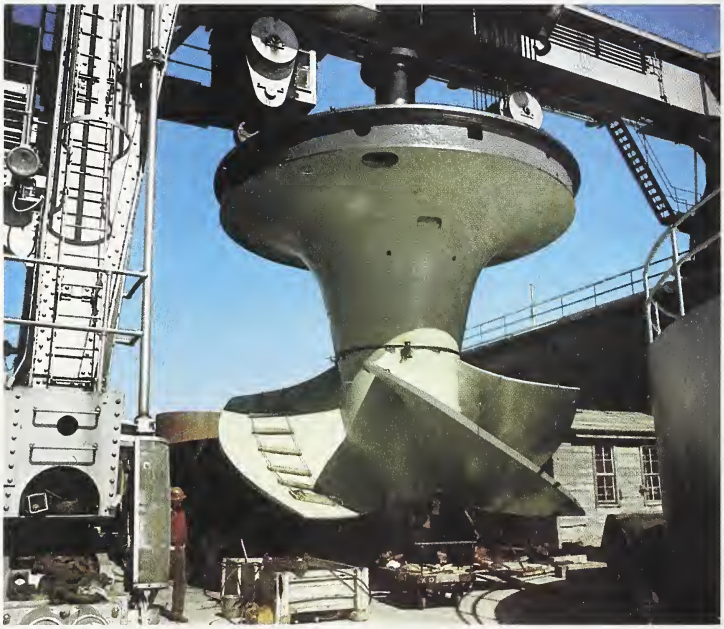
From power plants. You can get enough power to light a flashlight from a flashlight battery. You can get enough power to start a car with a car battery. But you need much more power to light the lamps and turn on the

[1] **Sample answer:** Because otherwise you might have to buy a new battery every few months.

Exploring on Your Own

You may want to know why car batteries give more power than flashlight batteries. Ask someone who works in a gas station or look up *storage batteries* in a reference book.

Sample answer for the caption: When you hook up a run-down battery to the battery of another car that is running, electricity from the battery in the running car travels through the run-down battery to start the stalled car. After the car runs for a while, the run-down battery becomes recharged. **Sample findings for "Exploring on Your Own":** Because an automobile storage battery has a series of metal plates, it produces about 1500 times more electricity than a flashlight battery.



Notice the large circular parts of the power plant shown in the top picture. Each part holds a large set of blades, as shown in the bottom picture. When these blades spin very fast, electricity is made. What do you think makes these blades spin?

Sample answer for the caption: Rushing water from the river.

Teaching help for the pictures above: Water to be used in a hydroelectric plant is usually dammed up, giving the water greater potential energy. As the water flows through special pipes, its force causes the huge blades of the generators to turn. If pupils are able to visit a hydroelectric-power plant at this time, it would be worthwhile. If this is not possible, those pupils who have visited such a plant might share their experience with the others in the class.

radio and TV in your home. This power comes from a *power plant,* where the electricity is made. This electricity reaches your town or city by means of power lines. You can often see these power lines running along roads. Lines coming from these power lines bring electricity to your house.

A power plant has a machine which makes the electricity. Certain parts of the machine must be made to move very fast to make electricity. In some power plants the machines are run by rushing water. This water may come from a dam on a river.

In other power plants the machines are run by steam. Steam can be made by burning fuel, such as coal or oil, to heat water. Atomic power can also be used to make steam.

Steam from the ground can also be used to make electricity. The center of the earth is very hot. This causes some of the underground water to become heated. When this water becomes hot enough, it turns into steam. If the steam is near a crack in the earth, it escapes. The steam can then be used to run machines that make electricity.

Why do you think companies that operate power plants look for new fuels to run their machines? [1]

Exploring on Your Own

Try to find out the source of energy used to run the machines in the power plant where your electricity comes from. Write a letter to the electric company asking for this information.

[1] **Sample answer:** Because some fuels now being used may become scarce.

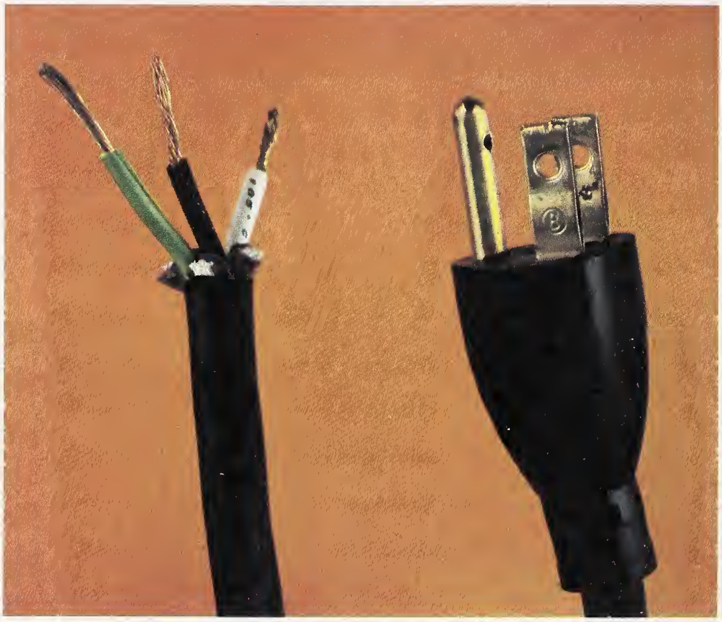
A Second Look

1. What is static electricity?
2. What is current electricity?
3. Where does the electricity to light a flashlight bulb come from?
4. How do power plants make electricity?

Sample answers for "A Second Look": 1. Static electricity is electricity which is caused by rubbing certain things together. 2. Current electricity is electricity which is made to move along wires. 3. The electricity to light a flashlight bulb comes from batteries. 4. Water or steam moves certain parts of the machines which make electricity in power plants.

2 Pathways for electricity

Think about the times you have plugged a cord into an outlet. You have probably done it many times. Maybe you have even seen the inside of a cord. If you have, you may know the cord is made up of wires covered by rubber or plastic. Why do you think the wires need to be covered?[1]



Conductors and insulators

Electricity flows easily through some things. Copper wire is one of these things. Electricity flows through many other metals, too. Things through which electricity flows are called *conductors* [kuhn-DUHK-turz]. What are some other metals that you think would be good conductors?[2]

[1] **Sample answer:** To keep people from getting a shock when handling the cord.

[2] **Sample answer:** Silver, aluminum.

Main concepts of the chapter (pages 106–113):

Electricity flows easily through some things, but not through others.

Current electricity must have a complete pathway in order to flow. This pathway is called a circuit.

In a series circuit, electricity has only one pathway to follow.

In a parallel circuit, electricity can follow more than one pathway.

Performance objectives: After studying the information provided in this chapter, the pupils should be able to

—identify the kinds of materials that are conductors of electricity and those that are not;

—demonstrate how to set up a complete circuit;

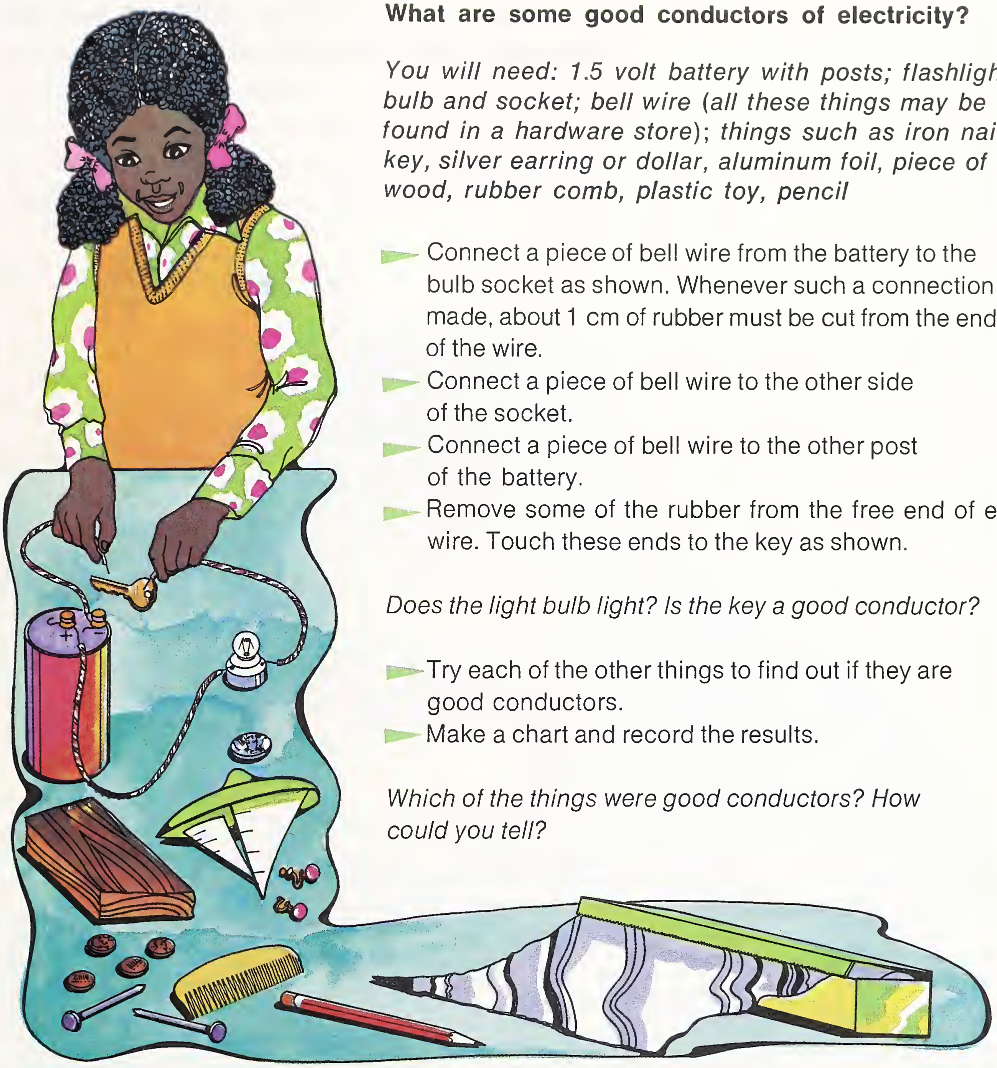
—demonstrate how to set up a circuit in series and a circuit in parallel.

Important words: conductors, insulators, electric circuit, series circuit, parallel circuit.

FINDING OUT

What are some good conductors of electricity?

You will need: 1.5 volt battery with posts; flashlight bulb and socket; bell wire (all these things may be found in a hardware store); things such as iron nail, key, silver earring or dollar, aluminum foil, piece of wood, rubber comb, plastic toy, pencil



- Connect a piece of bell wire from the battery to the bulb socket as shown. Whenever such a connection is made, about 1 cm of rubber must be cut from the end of the wire.
- Connect a piece of bell wire to the other side of the socket.
- Connect a piece of bell wire to the other post of the battery.
- Remove some of the rubber from the free end of each wire. Touch these ends to the key as shown.

Does the light bulb light? Is the key a good conductor?

- Try each of the other things to find out if they are good conductors.
- Make a chart and record the results.

Which of the things were good conductors? How could you tell?

Teaching helps for "Finding Out":
Processes used: observing, comparing, collecting data, communicating, inferring.
Sample findings: The silver earring, key, iron nail, aluminum foil, and other metal things are conductors of varying degrees. The bulb should light when the wires touch these conductors. The bulb will not light when the wires touch the nonconductors.

Electricity may not flow at all through other things. Glass is one of these things. Rubber is another. Things through which electricity does not flow are called *insulators* [IHN(T)-suh-LAYT-urz). What are some other things that you think are insulators?[1]

Sam Safety Says:

Stay alive! Beware of electricity!

When your hands or feet are wet, don't touch electrical things. You are a conductor when wet.

Don't put any objects into an electrical outlet.

Don't turn on too many appliances at one time.

Never touch a fallen electrical wire outdoors.

Don't experiment with electricity from an outlet at home or school.

Circuits

Current electricity moves along a complete pathway. This pathway is called a *circuit* [SUR-kuht]. In the simple circuit pictured at the right, the electricity begins flowing from the battery. It then goes through the wire to the light bulb. From the light bulb it continues through another wire back to the battery. There can be no space between conductors. All the metal parts must touch. What do you think it means when people say, "There's probably a bad connection"?[2]

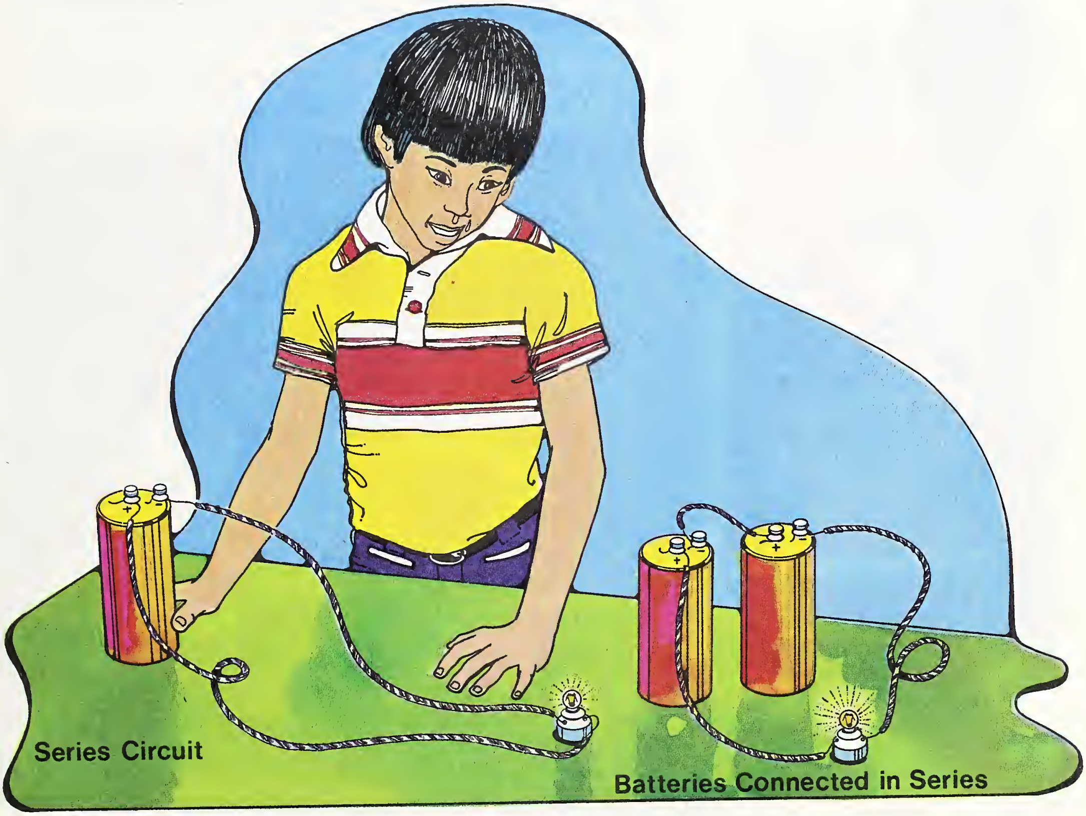
[1] **Sample answer:** Plastic, wood.

[2] **Sample answer:** It means that in part of the circuit some of the metal parts may be loose and may not always touch one another. This makes the light or the appliance go on and off by itself.

Teaching helps for "Sam Safety Says": Since electrical safety instruction should be emphasized in a unit on electricity, pupils may wish to make posters illustrating the safety measures suggested by "Sam Safety."

One pathway. Sometimes there is only one pathway that the electricity can follow. This is called a *series* circuit. The circuit in the picture on the left is a series circuit.

Batteries may also be connected in series. The picture at the right shows two batteries in series. Two batteries in series give twice as much power as one battery. You may have noticed this kind of connection in a flashlight where there are two or more batteries.



Teaching helps for the picture above: When two batteries are connected in series as in the picture on the right, the inner post (+) of one battery is attached to the outer post (—) of the other battery. The batteries the pupils have in flashlights and radios do not have posts. If the pupils wish to use the latter type of battery in setting up circuits, they must tape one end of a wire to the top (+) of one battery and tape the other end of the wire to the bottom (—) of the other battery.

Suppose you wanted to add another bulb to the series circuit shown at the left on page 109. You would find that each of the two bulbs would burn less brightly than one bulb. And if you loosened one of the bulbs, both bulbs would go out. Why?[1]

[1] **Sample answer:** Because there would not be a complete circuit then.

FINDING OUT

How can you show what happens if you add more bulbs to a series circuit?

You will need: 1.5 volt battery with posts, bell wire, 2 bulbs (1.5 volt) and sockets for them

- Cut two 15 cm pieces of bell wire and one 8 cm piece.
- Connect one 15 cm piece of wire to one battery post and to one side of a socket.
- Connect the other 15 cm piece to the other side of the socket and to the other battery post.
- Screw a bulb in the socket. Notice how bright the bulb shines. Unscrew the bulb. Add the other socket to the circuit, using the 8 cm wire to connect the 2 sockets.
- Screw in one of the bulbs.

What happens? Why?

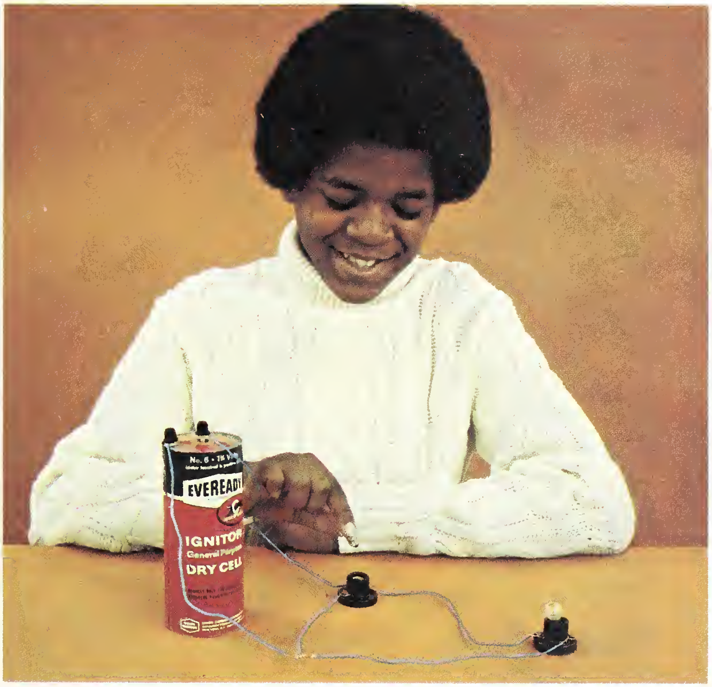
- Screw in the other bulb.

What happens now? In which circuit does each bulb shine more brightly? Why?

Teaching helps for "Finding Out":
Processes used: observing, comparing, communicating, inferring.
Sample findings: When a pupil screws in one bulb in a two-bulb series circuit, it will not light, because the circuit is not complete. After the second bulb is screwed in, both bulbs will light. The bulb in the one-bulb circuit will shine more brightly because all the electricity goes through that bulb. In the two-bulb circuit, the electricity is divided between the two bulbs.

Many pathways. A series circuit works well when you only have one bulb to light. But in your house you want to have several lamps on one circuit. So, the outlets in your house are wired in another way. They are wired in *parallel*.

The picture on this page shows a parallel circuit. Trace the paths that the electricity can follow. Start from the battery. How many paths can the electricity take before returning to the battery?[1] As you can see, a parallel circuit has more than one pathway for the electricity. That's why turning off one light does not break the circuit. If one bulb is off, the electricity still goes through the other bulb.



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[1] **Sample answer:** It has two different paths it could take.

Suggested activity: After discussing the material on this page, the pupils may wish to bring in some Christmas-tree lights that have been connected in parallel and some others that have been connected in series. The pupils may wish to light the Christmas-tree lights and explain how they can tell which are connected in parallel and which are connected in series.

There's another thing that makes parallel circuits better for your home. If you connect two bulbs in parallel, they do not shine less brightly than one bulb. Why do you think this is so? [1]

Imagine that many people in cars want to go to a ball game. If there were only one road to the ball park, what would happen to the traffic? But suppose there were many roads to the park. What would happen to the traffic then? Electricity works something like the cars in this example. It is easier for the electricity to go over many pathways than over one pathway. The electricity does not have to "work" so hard. So, it has more energy to light the bulbs. What do you think would happen if you added more bulbs and other things than the circuit could handle? Why? [2]

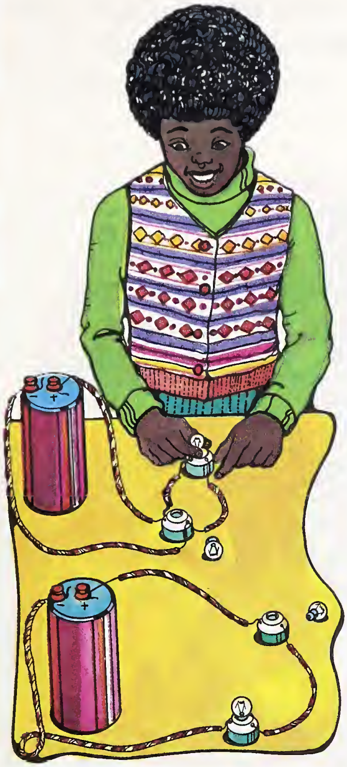
[1] **Sample answer:** Because each of the bulbs is getting the same amount of electricity as the other bulb.

[2] **Sample answers:** The circuit would burn out. Because the wires would get too hot.

Though a parallel circuit can handle many appliances, most houses have more than one parallel circuit. Why do you think this is so?

Sample answer for the caption: Because people often use more lights and appliances than would be safe for just one circuit.
Teaching helps for "Finding Out" (page 113): *Processes used:* observing, comparing, communicating, interpreting data.

Sample findings: The pupils will find that when two bulbs are connected in series and two bulbs are connected in parallel, the parallel circuit gives brighter light. This is because it is easier for the electricity to flow when there are two pathways to take than when there is just one. When



FINDING OUT

How can you show which kind of circuit is better for homes?

You will need: 2 batteries (1.5 volt) with posts, 4 sockets and 1.5 volt bulbs, bell wire

- Set up a battery with 2 light bulbs in a series circuit as shown. Unscrew 1 bulb until your other setup is ready.
- Set up a battery and 2 sockets connected in parallel as shown.
- Screw in all bulbs.

Which circuit gives brighter light?

- Unscrew one bulb in the parallel circuit.

What happens?

- Unscrew one bulb in the series circuit.

What happens?
Why is a parallel circuit better for homes?

A Second Look

1. What is meant by a conductor of electricity?
2. What is meant by an electric circuit?
3. How is a series circuit different from a parallel circuit?

the pupils unscrew one bulb in the parallel circuit, the other bulb will stay lighted. When the pupils unscrew one bulb in the series circuit, the other bulb will stop shining, too. A parallel circuit is better for homes because people can have several lights and appliances on one circuit and still get enough electricity for each. Also, with a parallel circuit, people can turn off one light or appliance without turning off all the others.

Sample answers for "A Second Look": 1. A conductor of electricity is anything through which electricity flows easily. 2. An electric circuit is a complete pathway along which electricity can flow. 3. In a series circuit the electricity has only one pathway along which to flow. In a parallel circuit there is more than one pathway along which the electricity can flow.

3 Controlling and measuring electricity

Most likely you turn lights and other things that use electricity "on" many times a day. There are other times when you want to turn these things "off." When might you want to turn things on or off?[1]

[1] **Sample answer:** I might want to turn on the radio or record player to listen to music and then turn it off when I'm finished.

Main concepts of the chapter (pages 114–125):

Switches, fuses, and circuit breakers are used to control electricity.

An electric meter measures the electric power used in a building.

Performance objectives: After studying the information provided in this chapter, the pupils should be able to

—demonstrate how a switch works;

—identify four kinds of switches;

—explain how switches can be made to work in pairs;

—explain how a fuse works;

—state what must be done before changing a fuse or switching a circuit breaker back on;

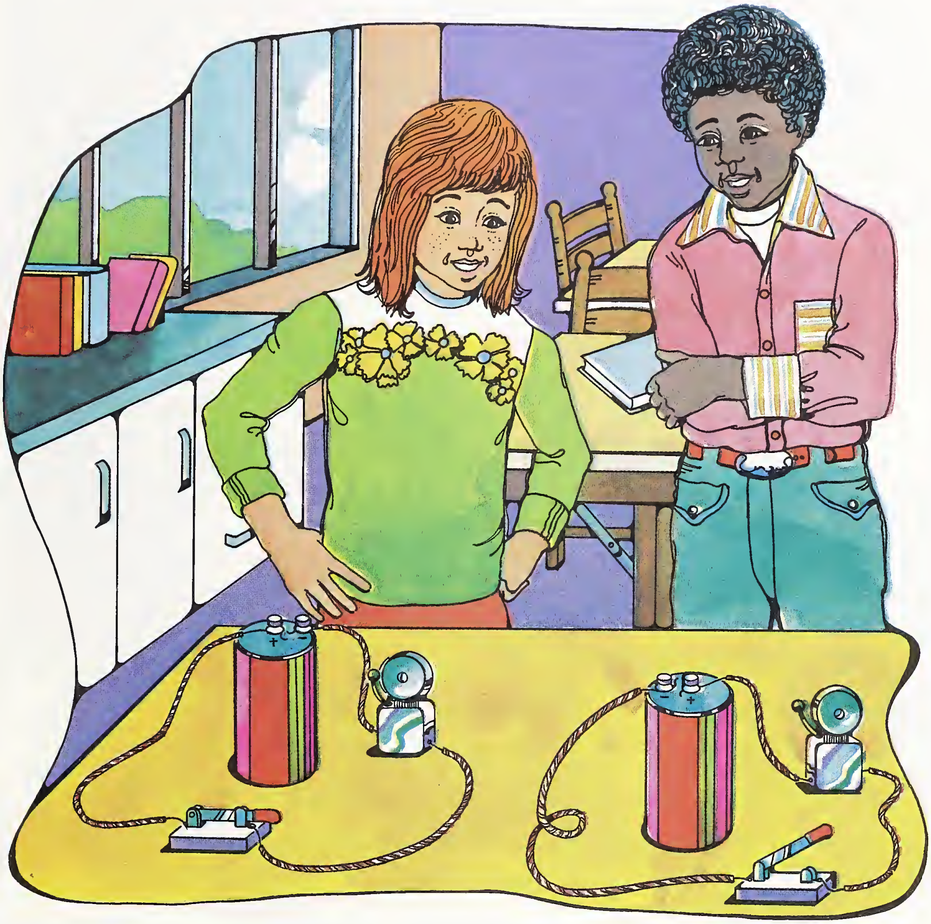
—locate the electric meter in their house or school.

Important words: switch, fuses, circuit breakers, electric meter, kilowatt-hours, watts, volts.

Which switch?

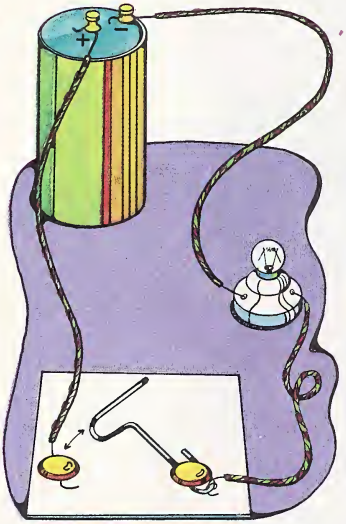
One way to turn electricity on and off is by using a *switch* in a circuit. Look at the switches in the circuits pictured on this page. Which of the circuits would allow electricity to flow? Why?[1]

[1] **Sample answers:** The one on the left. Because it's a complete circuit.



There are many kinds of switches. One kind is called a knife switch. When the blade of the switch is closed, it touches another metal piece. This gives the electricity a pathway along which to flow. When the switch is open, there is a space between the two metal pieces. The electricity does not have a complete pathway.

The rooms in your home probably have other kinds of switches. One kind they may have is a push-button switch. When you push one button in, the metal on the inside of the button touches another piece of metal. This closes the circuit. If you push the other button in, it opens the circuit. Another kind of switch is a flip switch. When you flip the switch on,



FINDING OUT

How can you make an electric switch?

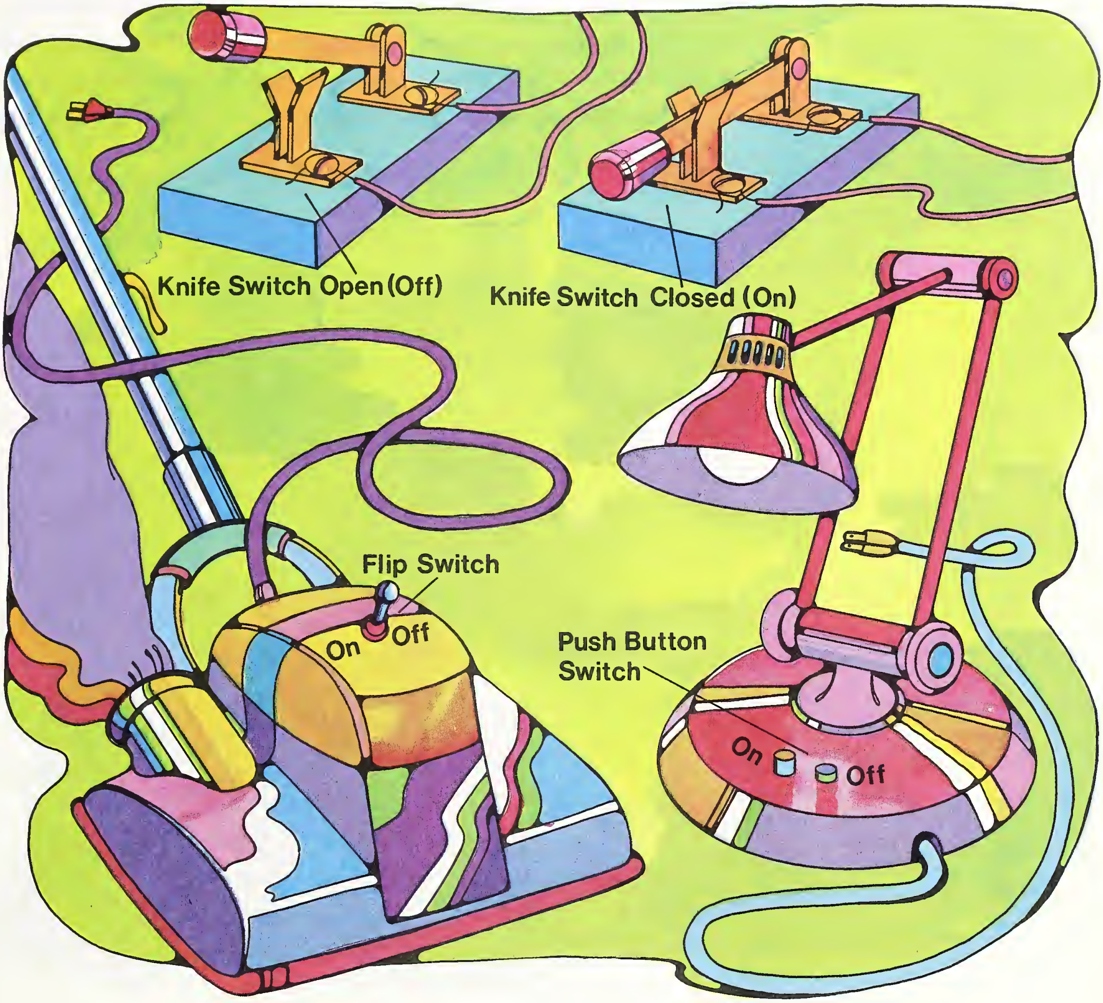
You will need: cardboard, scissors, wire, 2 paper fasteners, paper clip, 1.5 volt battery with posts, 1.5 volt bulb and socket

- Bend the paper clip as shown.
- Fasten the paper clip to the cardboard by means of a paper fastener at one end.
- Hook up your switch to a battery and a bulb socket as shown. Screw in the bulb.
- Close the switch.

What happens?
Explain how your switch works.

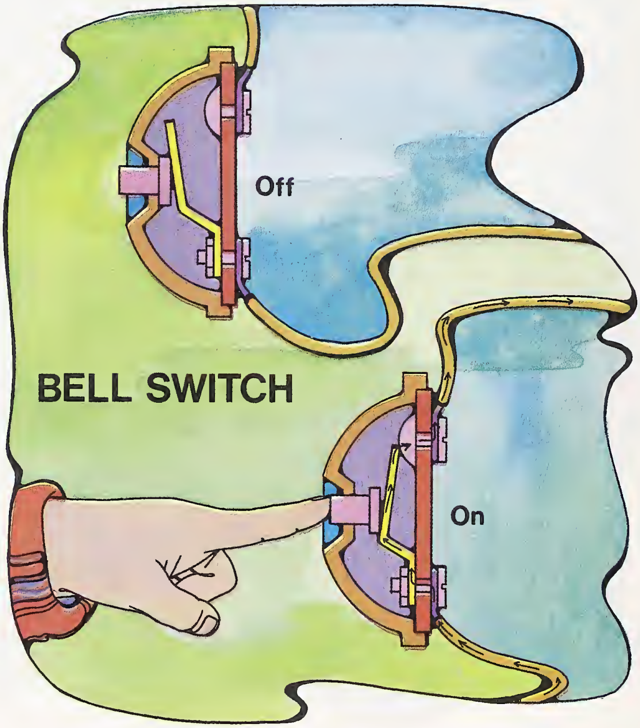
Teaching helps for "Finding Out":
Processes used: observing, communicating.
Sample findings: The pupils will find that when they close the switch made from a paper clip, the light bulb will shine. The switch makes contact with the wire and allows the electricity to flow through a complete circuit.

this closes the circuit. Some flip switches are silent. Instead of pieces of hard metal, liquid mercury is used to make the connection on these switches.



Teaching helps for the picture above: The pupils are most likely familiar with the types of switches in the picture. They may wish to check at home to see which appliances have each kind of switch.

Have you ever switched on a light with a flip switch and then forgotten to switch it off? What if you used a flip switch to ring a doorbell? What might happen?[1] To ring a bell, you want the electricity to flow through the circuit just for a short time. For this to happen, one piece of metal must touch another only when you press the button. When you stop pressing the button, a spring then snaps the button back. This opens the circuit again. This kind of switch is called a bell switch. At what other times might such a switch be useful?[2]



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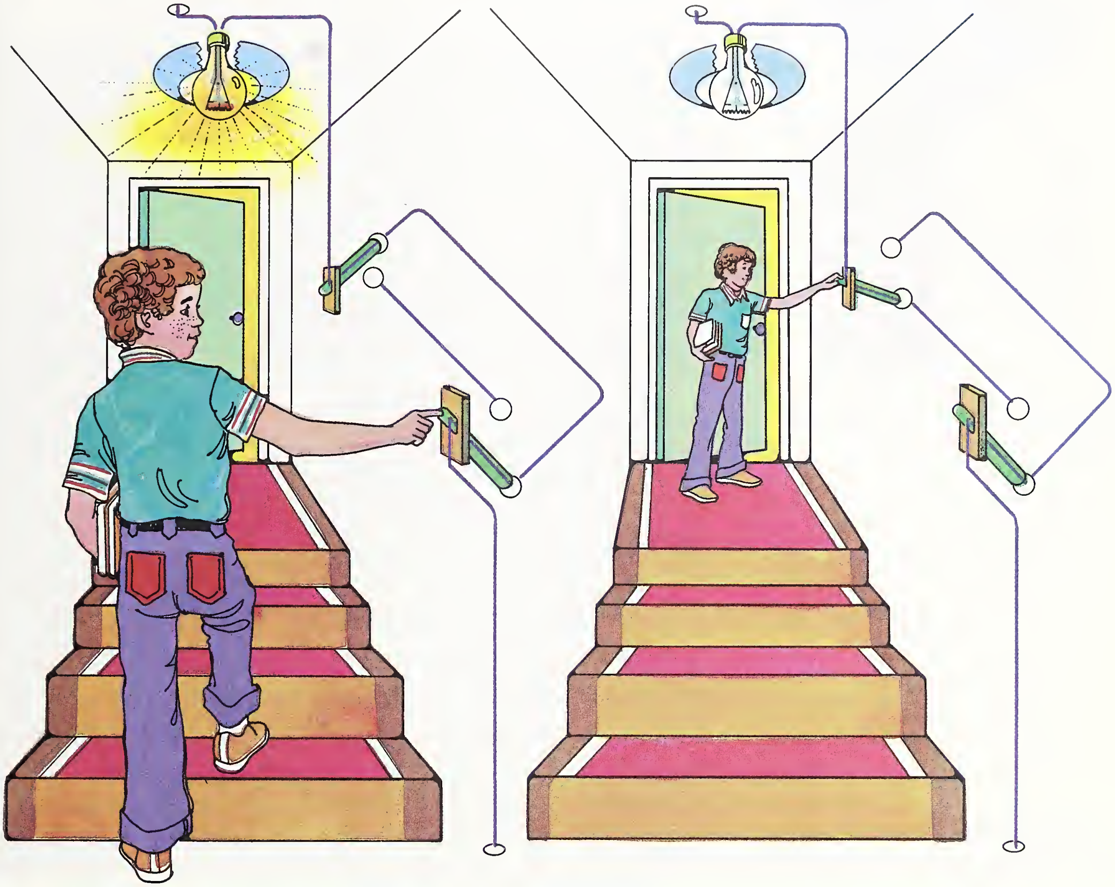
[1] **Sample answer:** You might flip on the switch and leave it on. It would keep on ringing.

[2] **Sample answer:** To light a light on a radio or a clock just for a short while in order to see the station or the time.

Switches sometimes work together. Have you ever noticed a light which can be turned on from either upstairs or downstairs or at opposite ends of a room? Look at the picture below and follow the path of the electricity. The path will change, depending on how you flip the switch. When is it helpful to have switches that work in pairs?[1]

[1] **Sample answer:** Whenever you would have to walk back and forth unnecessarily to turn off a light or appliance that you have turned on.



Teaching helps for the picture above: You may wish to call the pupils' attention to the fact that in the picture above, the wiring is made visible. They can't see the connections made with paired switches in their home because the wires are in the wall. After the pupils trace the path of electricity from the switch through the light, ask them where they think the electricity going to the switch comes from. (Sample answer: It comes from power lines outside the house.)

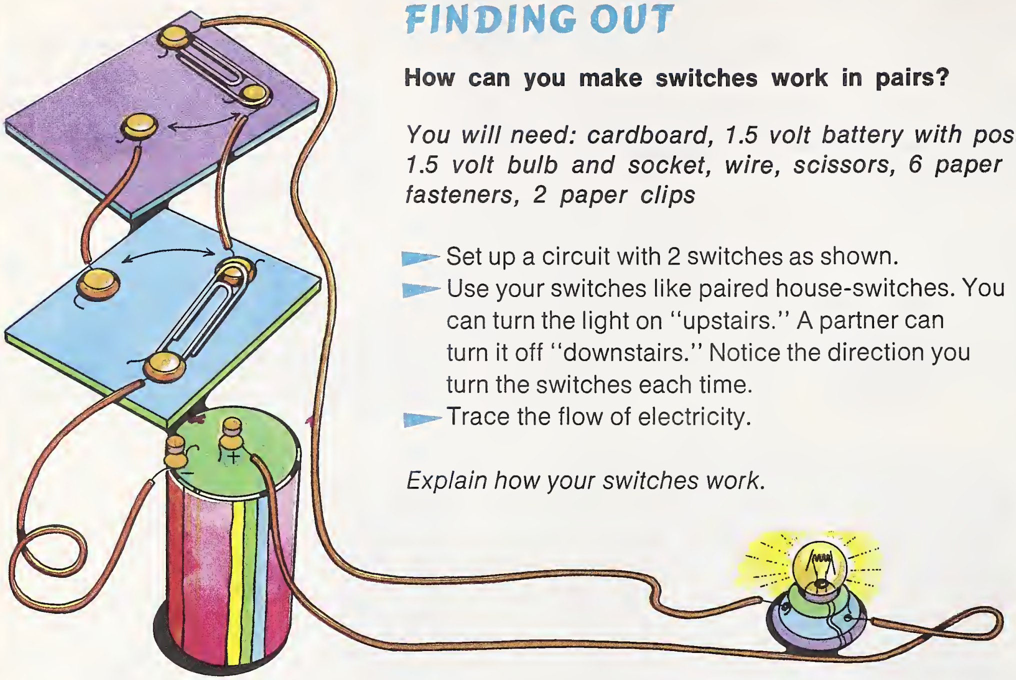
FINDING OUT

How can you make switches work in pairs?

You will need: cardboard, 1.5 volt battery with posts, 1.5 volt bulb and socket, wire, scissors, 6 paper fasteners, 2 paper clips

- Set up a circuit with 2 switches as shown.
- Use your switches like paired house-switches. You can turn the light on "upstairs." A partner can turn it off "downstairs." Notice the direction you turn the switches each time.
- Trace the flow of electricity.

Explain how your switches work.



Whose fuse?

As brought out before, you can turn electricity on and off by using switches. But there are other ways in which electricity can be controlled. Sometimes the covering on electric cords wears thin, and two wires may touch each other. This could cause a short circuit. When this happens, too much electricity goes through the wires. This may cause them to become hot—hot enough to cause a fire. How else do you think wires can become too hot? [1]

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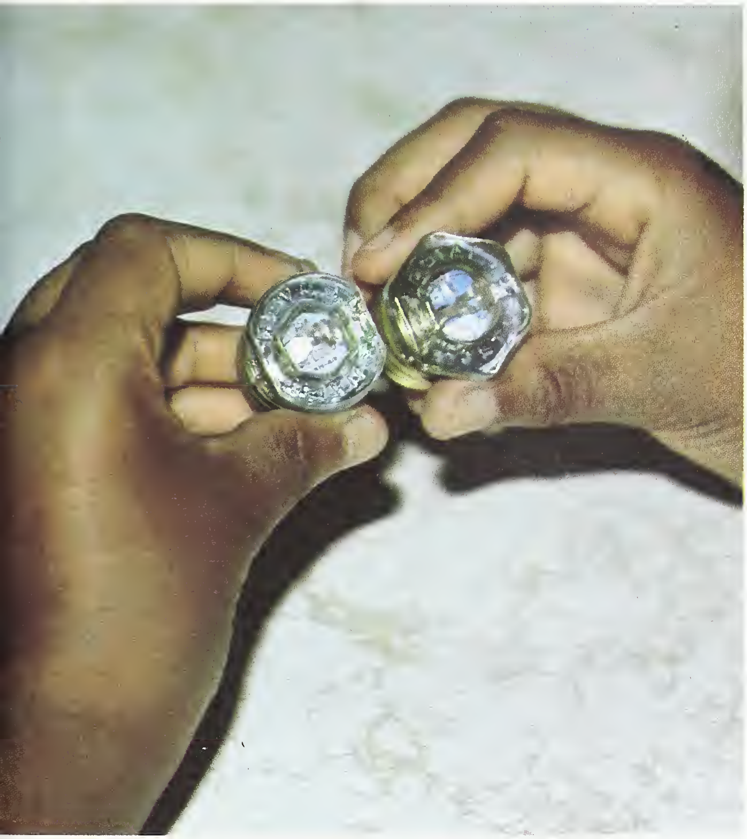
[1] **Sample answer:** When you turn on too many appliances at one time in a circuit.

Teaching helps for "Finding Out":
Processes used: observing, communicating.
Sample findings: The pupils will see that when the paper clips are in position to complete the circuit, the light bulb will shine. When the circuit is broken by moving the paper-clip switch over, the light will stop shining. The pupils may find it interesting that they can turn off the light by either switch.

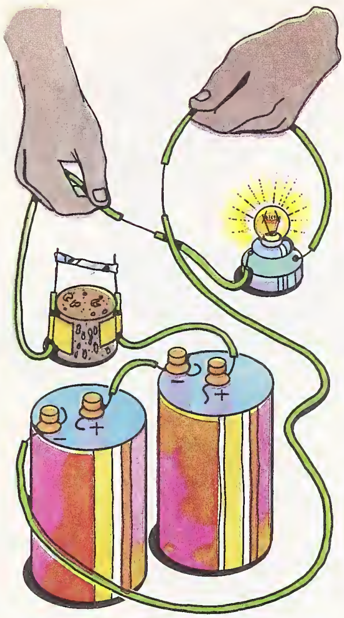
Suggested discussion: After discussing the paragraph on this page, the pupils may question why the wires heat up so much when they are touched together. You may point out to the pupils that in a short circuit, all the electricity from the electrical source goes through the wires and back to the source without being used up by lights or appliances. Too much electricity causes the wires to overheat.

To prevent fires caused by electricity, many buildings have *fuses.* They are connected to the circuit by means of a fuse box. Look at the picture of the fuses shown on this page. A fuse has a thin piece of metal across the middle. Suppose someone were to turn on too many things connected to the same circuit. The wires would become very hot. The thin metal in the fuse would melt, "blowing" the fuse. What do you think this would do to the circuit? Why? [1]

[1] **Sample answers:** It would break the circuit. Because when the fuse melts, the connection between the metal parts of the circuit is broken.



Teaching helps for the picture above: The pupils will see that the fuse on the left is "blown" because the metal has melted. The fuse on the right has the metal intact. It might be helpful for the pupils to bring in actual fuses, both "good" and "bad," for closer observation.



FINDING OUT

How can you show how a fuse works?

You will need: 2 batteries (1.5-volt) with posts, bell wire, flashlight bulb, socket, cork stopper, thin strip of aluminum foil from a gum wrapper, tape

- Make a fuse by taping 2 pieces of wire to the cork as shown. Connect the wires with the aluminum foil.
- Set up the circuit with the fuse as shown.
- Remove some of the rubber from the middle of 2 wires in the circuit.
- Screw the bulb in the socket.
- Now touch the 2 wires together where you have removed the rubber.

What happens to the fuse? Why? (If nothing happens, try making the aluminum foil thinner.)
What happens to the light? Why?

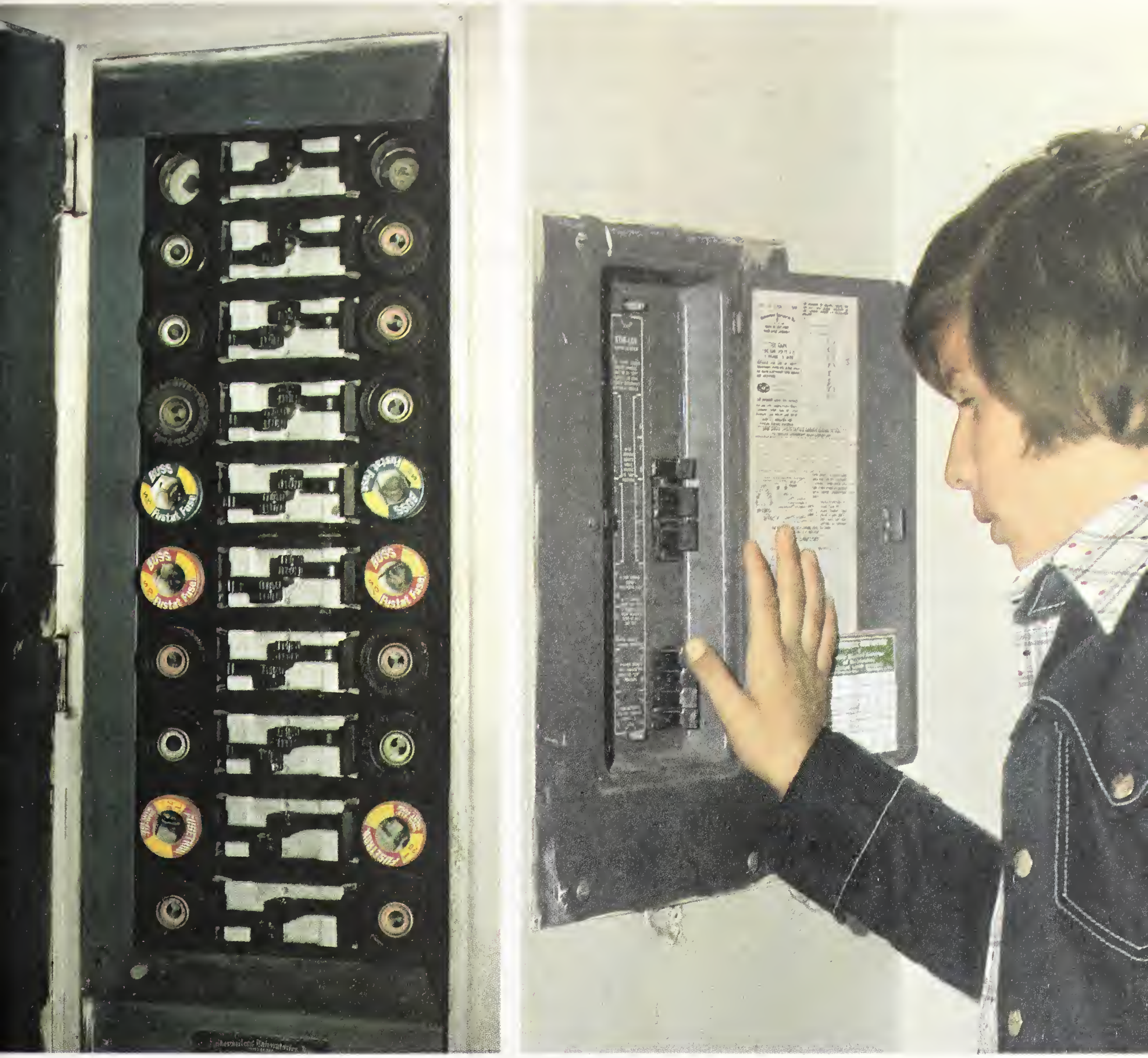
When a fuse melts, a new fuse has to be put in. But before this is done, whatever caused the fuse to "blow" should be taken care of. Why do you think this would have to be done?[1]

Although some houses are protected by fuses, other houses are protected by special switches. These switches are called *circuit breakers*. When too much electricity passes through a circuit, a switch flips to "off." This "breaks" the circuit. To complete the circuit again, someone must flip the switch back to "on." What do you think would happen if the person were to flip the circuit breaker to "on" before finding out what caused the circuit to be broken?[2]

[1] **Sample answer:** Because the fuse would blow again.

[2] **Sample answer:** The circuit breaker would switch off again.

Teaching helps for "Finding Out":
Processes used: observing, inferring, communicating.
Sample findings: The pupils will be causing a short circuit when they touch the two wires together. Too much electricity will flow through the short circuit, causing the wires to overheat. The aluminum foil (the fuse) will heat to the point of melting. When this happens, the circuit will break. The light will go out because the circuit is broken.



What do you think is one of the advantages of having circuit breakers (right) rather than fuses (left)?

Sample answer for the caption: Circuit breakers just have to be switched to "on" after the cause of the break has been adjusted, but new fuses have to be put in to replace "blown" fuses.

Teaching helps for the pictures above: The wires entering a building are all connected to a circuit-breaker box or a fuse box. All circuits within the building are also connected to the box. This way, all the electricity used in the building is controlled by the fuses or circuit breakers. Countless fires caused by electricity are avoided because of these built-in controls. The pupils may wish to find out which are used in their home—fuses or circuit breakers.

For You to Think About

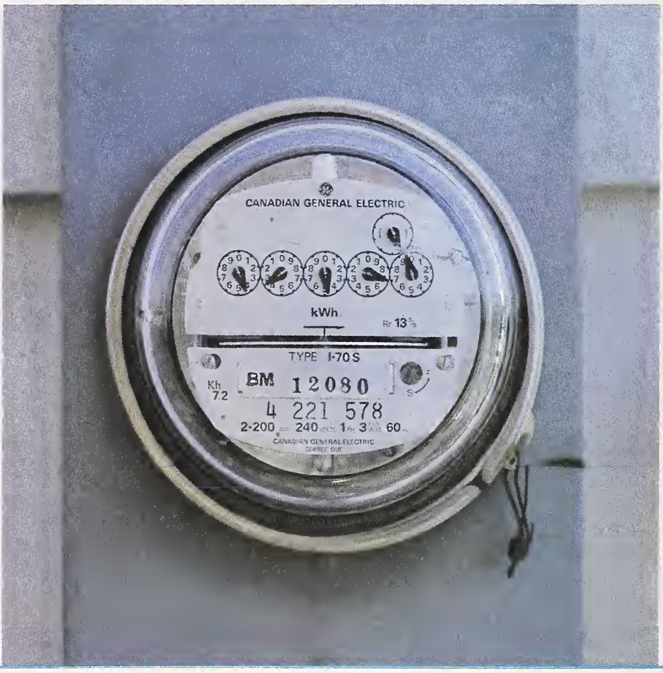
Some things that use electricity may be used only at certain times of the year. Air conditioners may be used only in summer. Electric blankets may be used only in winter. In what part of the year do you think your family uses more electricity? Why?

"Watts" up?

Have you ever seen an *electric meter*? If so, you may know that an electric meter is in the basement or on the outside of a house. You may also know that the meter is a box with dials on it. The dials may look like clocks. These dials keep track of how much electric power is being used in your house. Every month or so a meter reader from the electric company comes to your house. This person writes down how much electric power has been used since the last time the meter was read. The electric bill your family receives is based on the meter reading.

An electric meter measures the power used in *kilowatt hours*. If you turn on ten 100 watt bulbs for an hour, you would use 1000 watts in that hour, or 1 kilowatt hour of electricity. Do you think it is important to use electricity only when you have to? Why or why not?[1]

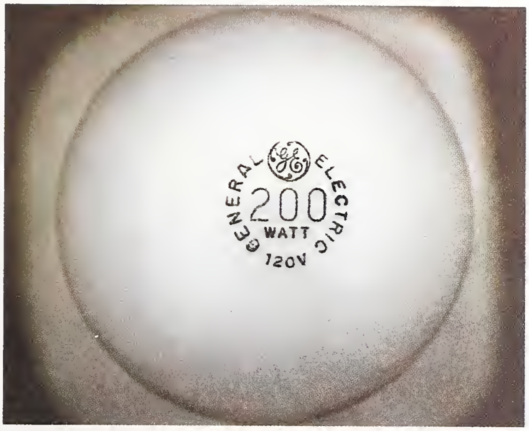
[1] **Sample answers:** Yes. Because otherwise you would just be wasting energy. Also, electricity costs money, so you would be wasting money by using electricity when you don't have to.



Sample answers for "For You to Think About": I think we use more in summer because of the air conditioner. I think we use more in winter because we have electric heat.

Teaching helps for the picture above: The pupils may wish to try reading the electric meter in the picture. From right to left, the dials stand for ones, tens, hundreds, and thousands. The "ones" dial must make one revolution before the "tens" dial moves one unit forward, and so on.

A light bulb most often shows how many watts the light bulb burns, such as 40 watts, 60 watts, or 100 watts. But it also shows something else. It also shows how much electric force is needed to light the bulb. This force is measured in *volts*. Most light bulbs and other things which use electricity in homes need a force of between 110 and 120 volts to work. There are some things in homes, such as some electric stoves, which need between 220 and 240 volts. Why do you think some things need more volts than other things?[1]



A Second Look

1. Why are switches often used in a circuit?
2. Why do you need one kind of switch to ring a doorbell and another kind to turn on a radio?
3. How does a fuse help control electricity?
4. How can you tell how much electricity is used in your home?

Exploring on Your Own

Look at a flashlight bulb to find how many volts it needs. Compare this with the number of volts a lamp bulb needs. Which needs more? Why?

[1] **Sample answer:** Heavy equipment, like stoves and washers and dryers, need more electrical force to make them work.

Teaching helps for the picture above: Pupils may have noticed the number of watts printed on light bulbs. Ask them which bulb would use the most electricity and give the brightest light: a 40-watt, a 60-watt, or a 100-watt bulb. Call attention to the bottom number on the bulb in the picture: *120V*. Ask them what the *V* stands for. (Answer: *V* stands for volts.)

Sample answers for "A Second Look": 1. Switches are used to turn lights and appliances on and off. 2. You want to ring a doorbell for just a short while, but you want a radio to stay on for a long time. 3. The thin metal strip in a fuse melts and breaks the circuit whenever there are too many appliances turned on. 4. You can read the electric meter to tell how much electricity is used.

Sample answers for "Exploring on Your Own": The lamp bulb needs more volts because its filament is heavier than the filament in a flashlight bulb.

4 How does electricity help you?

Electricity helps you in many ways every day. How has it helped you so far today?

Turning on the heat

Maybe you toasted bread in an electric toaster for breakfast today. You may have eaten an egg cooked on an electric stove. Perhaps you are wearing something pressed with an electric iron. Electric toasters, stoves, and irons all use electricity to make heat.

Main concept of the chapter (pages 126–143): Electricity can help you by heating things, by lighting lights, by running motors, by keeping you in touch with others, and by bringing you fun with radio and TV.

Performance objectives: After studying the information provided in this chapter, the pupils should be able to

—state at least five ways in which electricity is helpful in their life;

—explain how light bulbs light up;

—demonstrate how to make an electromagnet;

—state how telegraph messages are sent over wires;

—explain how radio and TV signals are transmitted to their home.

Important words: magnet, electromagnet, telegraph, teleprinter, telephone, radio, TV, microphone, radio waves.

Toasters, stoves, and irons have special wires in them. When electricity passes through these wires, they become hot. Heat from these wires then toasts the bread, cooks the egg, or helps press your clothes. In what other things does electricity make heat?[1]

[1] **Sample answer:** In electric ovens, electric frying pans, food warmers, electric heaters.

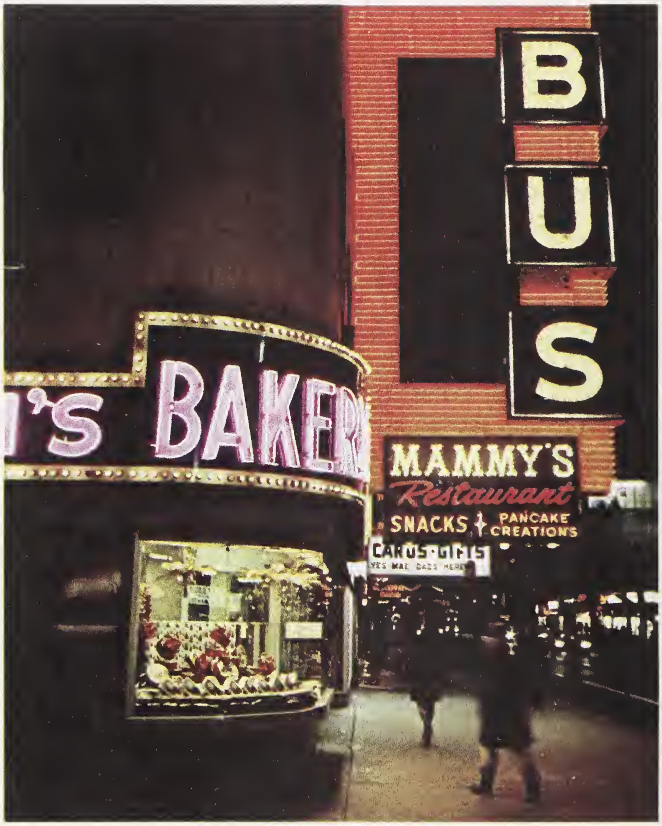
Brightening your days and nights

You may have noticed that as the wires in a toaster heat up, the wires begin to glow with a red light. When other things become very hot, they may also give off light. Light bulbs work in this way. One kind of light bulb has a thin wire in it. When electricity flows through this wire, the wire becomes very hot. It gives off a bright light.

Teaching helps for the picture above: The pupils can see the wires glowing in the bulbs in the picture. You may ask the pupils what makes a bulb burn out. (Sample answer: The wire inside burns up and breaks.) Some of the pupils may wish to bring in a burned-out bulb and a good bulb to make comparisons.

As you may know, air is needed to make things burn. To keep the wire in a light bulb from burning, air is taken out of the bulb. Because of this, the wire will glow but not burn.

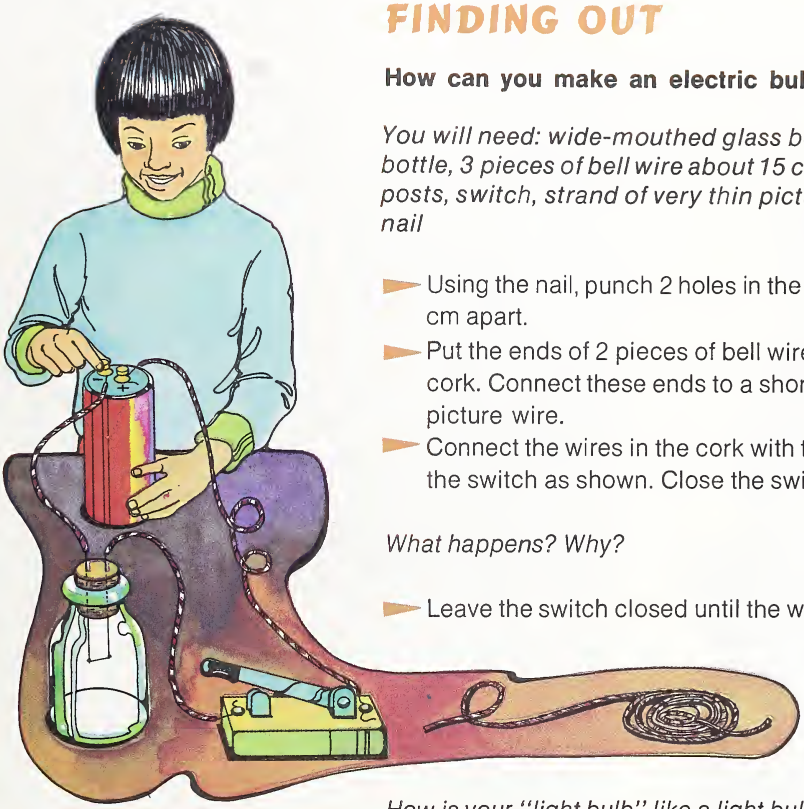
Some light bulbs do not have wires in them. You may have seen signs that light up in many colours. These signs have tubes with a gas in them. The gas glows when electricity passes through it. The colour of the light depends on the kind of gas inside the tube.



Suggested activity: Your pupils may wish to find out what kind of coloured lights are used in nearby stores and other buildings. Tell the pupils to notice whether the lights are coloured bulbs with wires or tubes with coloured gas.

There is another kind of light bulb that does not have wires in it. It also has a gas inside. When electricity heats the gas, a substance painted on the inside of the light bulb glows. Where have you seen light bulbs without wires in them?[1]

[1] **Sample answer:** In the lights in school.



FINDING OUT

How can you make an electric bulb?

You will need: wide-mouthed glass bottle, cork for the bottle, 3 pieces of bell wire about 15 cm long, battery with posts, switch, strand of very thin picture wire, long thin nail

- Using the nail, punch 2 holes in the cork about 2 cm apart.
- Put the ends of 2 pieces of bell wire through the cork. Connect these ends to a short strand of picture wire.
- Connect the wires in the cork with the battery and the switch as shown. Close the switch.

What happens? Why?

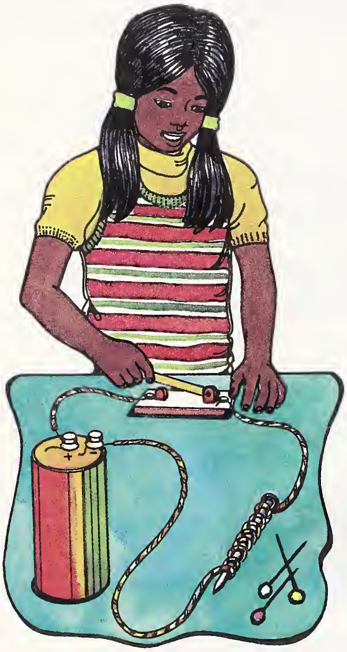
- Leave the switch closed until the wire burns out.

How is your "light bulb" like a light bulb in your home? How is it different?

Teaching helps for "Finding Out":
Processes used: observing, comparing, inferring, communicating.
Sample findings: The pupils will find that the wire will glow when electricity passes through it. This happens because the thin wire offers a great deal of resistance to the flow of electricity. This causes the wire to heat up. When it gets very hot, it glows. The "light bulb" in the "Finding Out" is like a light bulb at home because the electricity has to flow through a very thin wire in it. But the light bulb at home will glow more brightly.
Additional information: The tungsten wire in the real light bulb can glow more brightly than the picture wire. The air has been pumped out of the commercial light bulbs to keep the wires from burning out too quickly, whereas the air in the pupils' "light bulb" causes the wire to burn out in a short time.

Making work easier

Have you ever seen or used a *magnet* [MAG-nuht]? If so, you know it can be used to pick up certain things. You may also know that a magnet is made of a special kind of metal. Such a magnet seems to work "by itself." Some magnets work in another way. They must have a wire wrapped around them. Electricity must also be running through the wire. This kind of magnet is called an *electromagnet*.



FINDING OUT

How can you make an electromagnet?

You will need: battery with posts, bell wire, switch, large iron nail, pins

- Wrap a piece of bell wire several times around the nail, leaving the ends of the wire free.
- Connect the wires around the nail with the battery and the switch as shown.
- Close the switch. Bring the nail close to the pins.

What happens to the pins?

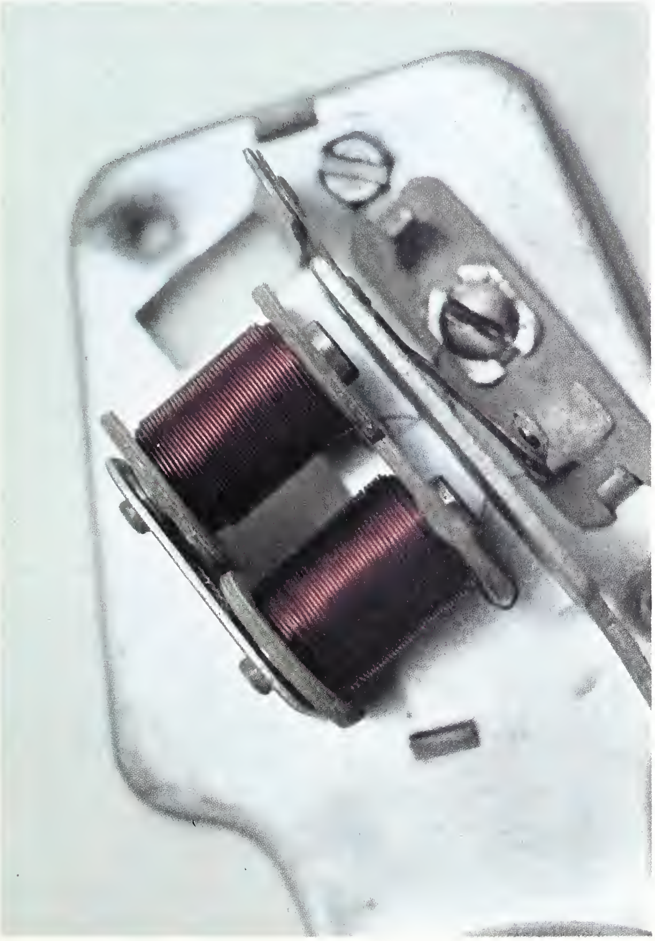
- Open the switch. Bring the nail close to the pins.

What happens to the pins?
When is the nail a magnet?
In what ways might you make your magnet stronger? Try it.

Teaching helps for "Finding Out":
Processes used: observing, inferring, communicating.
Sample findings: The pupils will find that the nail acts like a magnet when electricity is flowing through the wire. It does not act like a magnet when electricity is not flowing through the wire. To make the magnet stronger, the pupils might try wrapping more turns of wire around the nail. Some pupils may wish to use another battery connected in series to see if that increases the strength of the electromagnet.

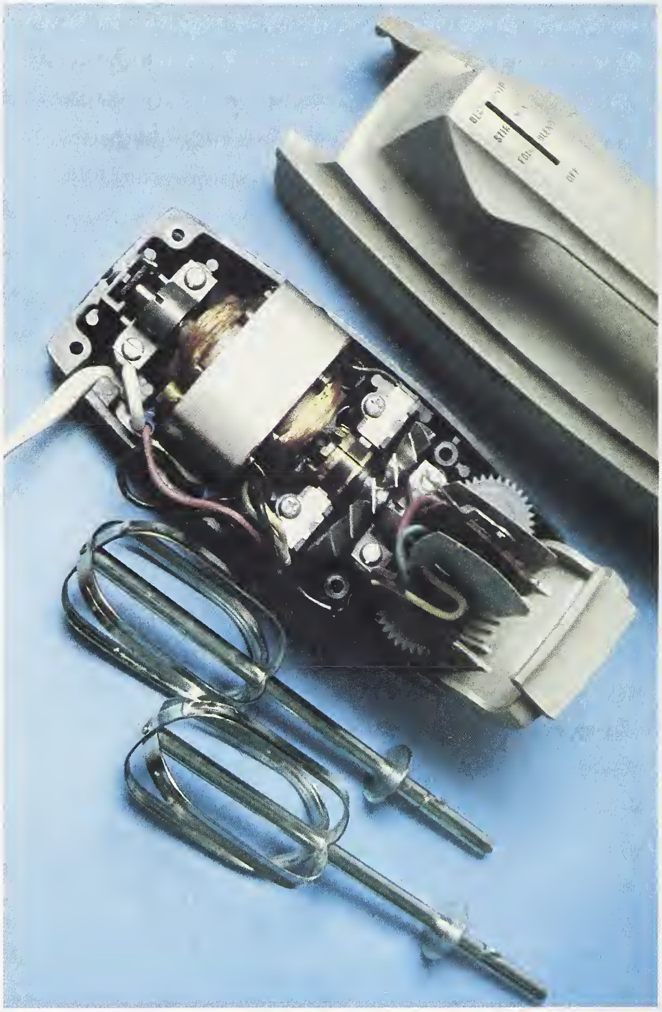
Electromagnets are used in many of the things you may have in your home, such as an electric doorbell. Electromagnets are also used in electric motors. Think of some of the things run by electricity in your house. Which of these things have moving parts?[1] These things most likely have an electric motor.

[1] **Sample answer:** Blenders, electric can openers, electric beaters.

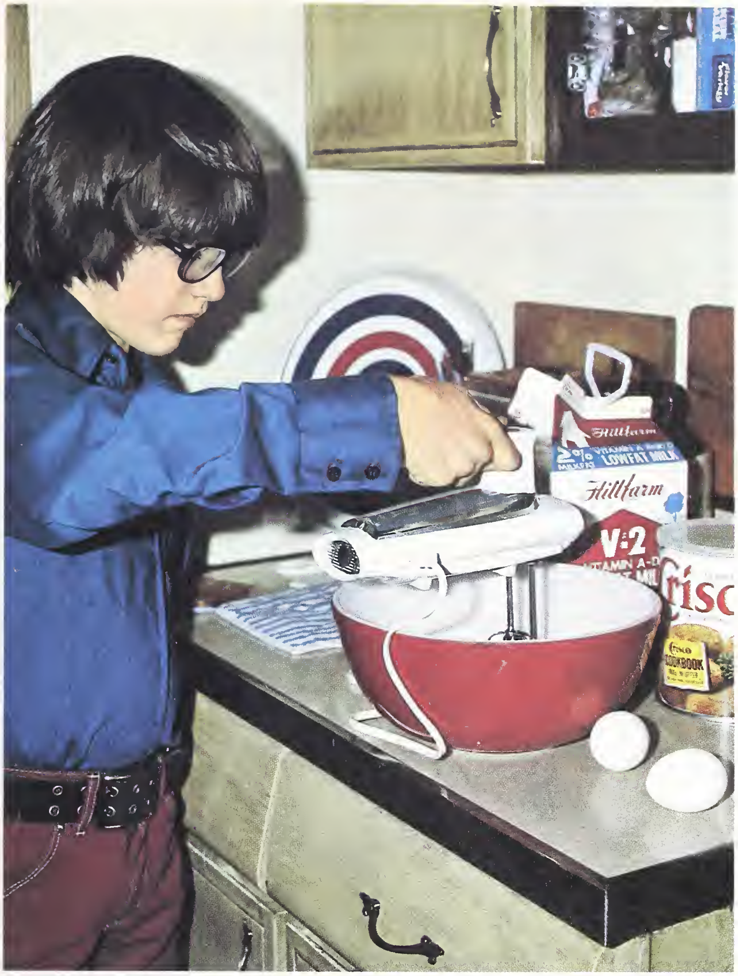


The inside of this doorbell has two electromagnets. When the electricity is turned on, these electromagnets make the long piece of metal move back and forth very quickly, striking the bell.

The picture on this page shows the inside of an electric motor. A motor has two magnets. The outside magnet is an electromagnet. Inside of this magnet there is another magnet. The inside magnet spins around



The wide metal piece across this motor is an electromagnet. The copper wire inside the magnet is part of another magnet. When the eggbeater is turned on, the inside magnet spins, causing the beaters to spin.



when electricity flows through the electromagnet. When the inside magnet spins, it makes whatever is hooked up to it move.

Other than in your house, where else might electric motors be used?[1]

[1] **Sample answer:** In school for electric pencil sharpeners and in factories for machines that lift things.

Suggested activity and research: After discussing "Making work easier" on pages 130–133, the pupils may wish to make a list of everything in the classroom and at home that has an electric motor. They may wish to bring some small item with a motor, such as a toy, to school. Some pupils may wish to learn more about how motors work. They might look in reference books under the heading *electric motor*.

Keeping you in touch

Electricity can help you in still another way. It can help you receive messages from someone far away. It can also help you send messages to someone. Why might you want to send such messages?[1]

Telegraph. Suppose you wanted to send a message quickly to someone across the country. You could go to a *telegraph* office. Telegraph offices have machines which send and receive messages over wires.

One of these machines, the *teleprinter,* looks like a typewriter. A message you want to send is typed on the teleprinter. The teleprinter changes the message to electric signals. These signals are then carried over

[1] **Sample answer:** I might want to send a greeting on someone's birthday or when someone is sick.

Teaching helps for the picture above: The teleprinter, or teletypewriter, shown in the picture has replaced the telegraph system using the Morse code. In some parts of the world, however, the Morse code is still used. To familiarize the pupils with how telegrams are sent today, you may wish to have the pupils visit a telegraph office. The pupils should be made aware that newspaper stories are also sent and received on teleprinters. Many business firms use another type of machine to send photographic copies of printed material over the wires.

wires to a telegraph office near where you want your message sent. At that office, the signals cause your message to be typed on paper by another machine. The message is often phoned from the office to the person you want to be in touch with.

Pictures can also be sent in this way. When might people want to send pictures quickly over a long distance?[1]

[1] **Sample answer:** Newspapers might want to send a picture to accompany a story.

Telephone. You probably send and receive most messages by *telephone.* A telephone also carries messages over wires. As you most likely know, a telephone has a mouthpiece. When you talk into the mouthpiece, your voice is changed into electric signals. These signals are then carried along wires to the phone of the person you are calling. These signals are changed back into your voice sounds in the other person's earphone. This is how that person can hear your voice from many miles away.

With whom do you like to keep in touch over the telephone?

Suggested activity: Pupils often use the telephone for things that are important to them. Have the pupils keep a list of the telephone calls made and received by them in one week that were important to them.

Bringing you fun

Electricity can also bring you many kinds of fun. *Radio* and *TV* are run by electricity. What fun have you had from radio and TV?

Radio. Many people enjoy music and programs on the radio. They enjoy these programs at home, in their

For You to Think About

Sometimes people like to play music while they take a shower. But your body is a conductor of electricity, especially when wet. Why do you think it is dangerous to touch a plugged-in radio while taking a shower?

Towers, such as the ones on this building, broadcast TV programs. Where have you seen such towers?

Sample answers for "For You to Think About": It's dangerous because you might become a part of the circuit. Electricity would flow through you.

Sample answer for the caption: On the top of a very tall building in a city.

For You to Think About

Imagine for a moment that there were no electricity. In what ways do you think your life would be different?

cars, or out on picnics. When do you listen to the radio?

A radio program begins in a studio. Someone speaks or sings into a *microphone*. Just as a telephone changes voice sounds into electric signals, so does a microphone. The signals change according to the voice of the person speaking into the microphone. These signals are made very powerful so that they can be carried by *radio waves* over many miles. Radio waves do not need wires. They travel through the air or through space.

A radio that is tuned in miles away can pick up these signals. These signals are then changed back to sound by the radio loudspeaker. This is how you can hear the voice of someone speaking at the radio station.

How do you think radio waves were helpful when the astronauts went to the moon?[1]

Television. In addition to enjoying radio programs you may also enjoy TV. Which TV programs do you like to watch?

As does a radio program, a television show begins in a studio. In a television studio, special cameras take motion pictures of the show. These pictures are changed to one kind of electric signal. The sound picked up by microphones is changed to another kind of electric signal. These two signals are then combined to make the *TV signal*. TV signals reach your home by means of waves which work like radio waves.

When you turn on your TV set, the TV signals are changed back to pictures and sound. You can see and hear the show just as it is taking place in the studio.

Besides bringing people fun, in what other ways is television helpful to people?[2]

[1] **Sample answer:** Radio waves carried messages and pictures from the moon and kept the astronauts in touch with the earth.

[2] **Sample answer:** It brings news, sports, and educational programs to people.

Sample answers for "For You to Think About": I would have to use a candle or a kerosene lantern to see at night. I'd have to toast bread on a fire. There would be no radio, TV, or movies.

Suggested activity and research: After discussing "Radio" on pages 137 and 138, the pupils may wish to experience, by means of a simple experiment at home, how signals are carried by radio waves. Have the pupils tune their radio to a place between stations the next time someone at home is using an electric mixer or a hair dryer. See if they can "hear" the mixer or dryer on the radio. When the mixer or dryer is turned off, see if they still get a signal on the radio. Pupils may wish to experiment with other electric signals, such as the doorbell. They may wonder why there is no signal noticeable when the radio is tuned to a station. They may wish to ask a person who repairs radios or look it up in reference books under *radio* or *radio waves*.

A TV program is being made in this TV studio. What things in this picture that are run by electricity are needed to make the program?

A Second Look

1. What part of a toaster or an iron makes heat?
2. What is an electromagnet?
3. How is an electromagnet used in a motor?
4. How do radio and TV shows get from a studio to your home?

Sample answers for the caption: The camera, the lights, the microphone, the sound system.

Sample answers for "A Second Look": 1. The wires in a toaster or in an iron make heat. 2. An electromagnet is a piece of metal with wires wrapped around it which acts like a magnet when electric current is flowing through the wires. 3. The electromagnet in a motor makes another magnet in the motor spin around. When the other magnet spins, it makes whatever is hooked up to it move. 4. Radio and TV shows are carried by special waves from a studio to my home.

Every day people use electricity in homes, schools, and other buildings. When a building is being built, someone must put in the electric wires according to the plans. This person is the *electrician.*

In order to wire a building, electricians must know many things about electricity. They must know how to connect the wires to the outlets. They must know how to install fuse boxes. And they must make sure that everything is wired so that the building is safe.

After a building is built, the electrician may be called in to do many things. The electrician may have to replace worn-out wires. Or the electrician may have to put in another circuit for some new machinery. Sometimes people in the building want another outlet put somewhere. The electrician does all these things.

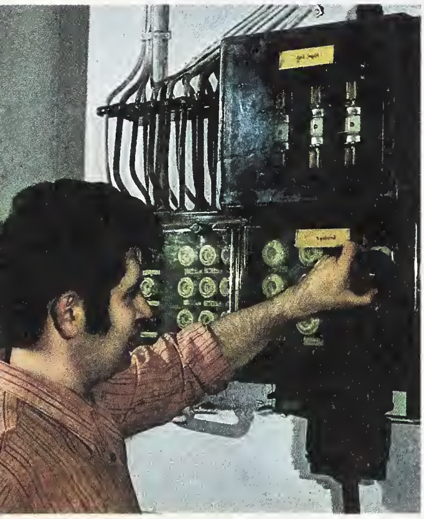
To find out more about electricians, try to find answers to these questions:

How can an electrician find out how a house is wired if the electrician does not have the plans?[1]

What safety precautions does an electrician have to take while working?[2]

What are some other things an electrician might do?[3]

You may wish to use reference books or write to the Canadian Electrical Association, One Westmount Square, Montreal, Quebec H3Z 2P9.



This electrician is checking a fuse box to see if it is working properly. How might this be helpful to the people in the building?

Sample answers for "Workers Who Use Science":

[1] Electricians have special tools to test for electricity. They test the circuit parts they can see. Then they are able to figure out what the hidden parts are like.

[2] An electrician should wear rubber-soled shoes when working. The electrician must be careful never to work with electricity with wet hands or feet. When repairing a wire, the electrician must make sure that the wire is not at that moment a part of an electric circuit. The electrician must often work with tools that are properly insulated.

[3] Electricians may also put in new fixtures or repair some electrical appliances.

Sample answer for the caption: Fuses prevent many fires by breaking overloaded circuits before the wires get hot enough to cause fires.

Reviewing the Main Ideas

Rubbing certain things together sometimes causes static electricity.

Electricity which moves along wires is current electricity.

Current electricity comes from batteries and power plants.

The machines that make electricity in a power plant are run by rushing water or steam.

Electricity flows easily through some things, but not through others.

Current electricity must have a complete pathway in order to flow. This pathway is called a circuit.

In a series circuit, electricity has only one pathway to follow.

In a parallel circuit, electricity can follow more than one pathway.

Switches, fuses, and circuit breakers are used to control electricity.

An electric meter measures the electric power used in a building.

Electricity can help you in many ways.

Reading About Science

Asimov, Isaac. *How Did We Find Out About Electricity?* Pickering, Ontario: Beaverbooks, 1973.

Loubser, Leon. *Making Electricity*. Toronto, Ontario: Macmillan Company of Canada Ltd., 1975.

Reviewing the unit: You may wish to have the pupils study "Reviewing the Main Ideas" to help prepare for "Testing for Understanding" on page 142.

For further reading: You may wish to encourage the pupils to read the books listed under "Reading About Science" and other books and articles related to the topic of electricity. Such articles might be found in reference books under the headings *electric meters, electric motors, electromagnets, radio, telegraph, telephone,* and *television.*

Testing for Understanding

Ideas to Check

On your paper write *T* for each sentence below that is true. Write *F* for each one that is false.

T 1. Static electricity comes from rubbing certain things together.
T 2. Car batteries have more power than flashlight batteries.
F 3. Rubber is a good conductor of electricity.
F 4. If you turn out one lamp in a parallel circuit, all the other lamps in that circuit will go out.
T 5. Fuses can help prevent electrical fires.
F 6. Radio waves must have wires in order to travel.
T 7. Circuit breakers are often used to control electricity.

Words to Use

Write on your paper the word or words that best fit in each blank below. Choose from these words: *magnets, radio waves, switches, parallel, battery, steam, electrons, motor, series.*

1. Electricity is turned on and off by ____. switches
2. The power to light a flashlight bulb comes from a ____. battery
3. The two ____ in a motor make parts of the motor move. magnets
4. Machines which make electricity are sometimes run by ____. steam
5. Electric signals from a radio station reach your home by ____. radio waves
6. When electricity has more than one pathway it can take, the circuit is a ____ circuit. parallel

Suggestions for evaluation: You may wish to use the test questions under "Testing for Understanding" to evaluate the pupils' understanding of the main ideas and important words of this unit. Additional test questions for the unit "Electricity on the Move" are provided for you on page T18 of the Teacher's Manual. These test questions may be duplicated for classroom use. Answers to these additional test questions can be found on page T22 of the Teacher's Manual.

Having Fun with Science

What Am I?

Pulling me *out* makes water flow.
Putting me *in* makes light bulbs glow.[1]

On buses, I collect.
In circuits, I connect.[2]

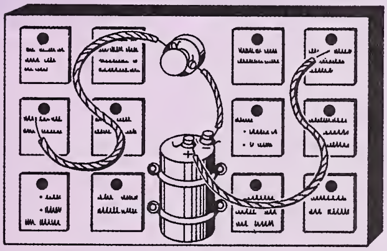
I carry your voice over miles of wire,
While you sit at home and do not tire.[3]

Things to Do

1. Sometimes electric-repair shops have some old electric switches. Ask someone who works at one of these stores if you can have some of these switches. Take the switches apart. Figure out how they work.

2. See if you can find out how much electricity is used by your family in a month. Read the meter at the beginning of the month. Read it again at the end of the month. Find out how much your family has to pay for electricity in a month.

Mystery Answer-board



The picture at the left shows a "mystery answer-board." There is a piece of metal next to every question on the left. There is a piece of metal next to every answer on the right. With one end of a wire, you can touch the metal next to a question. With the other end of the wire, you can touch the metal next to the answer you think is right. If you are right, the light bulb will light up. How do you think the back of the board is wired so this can happen? Try to make your own mystery answer-board.

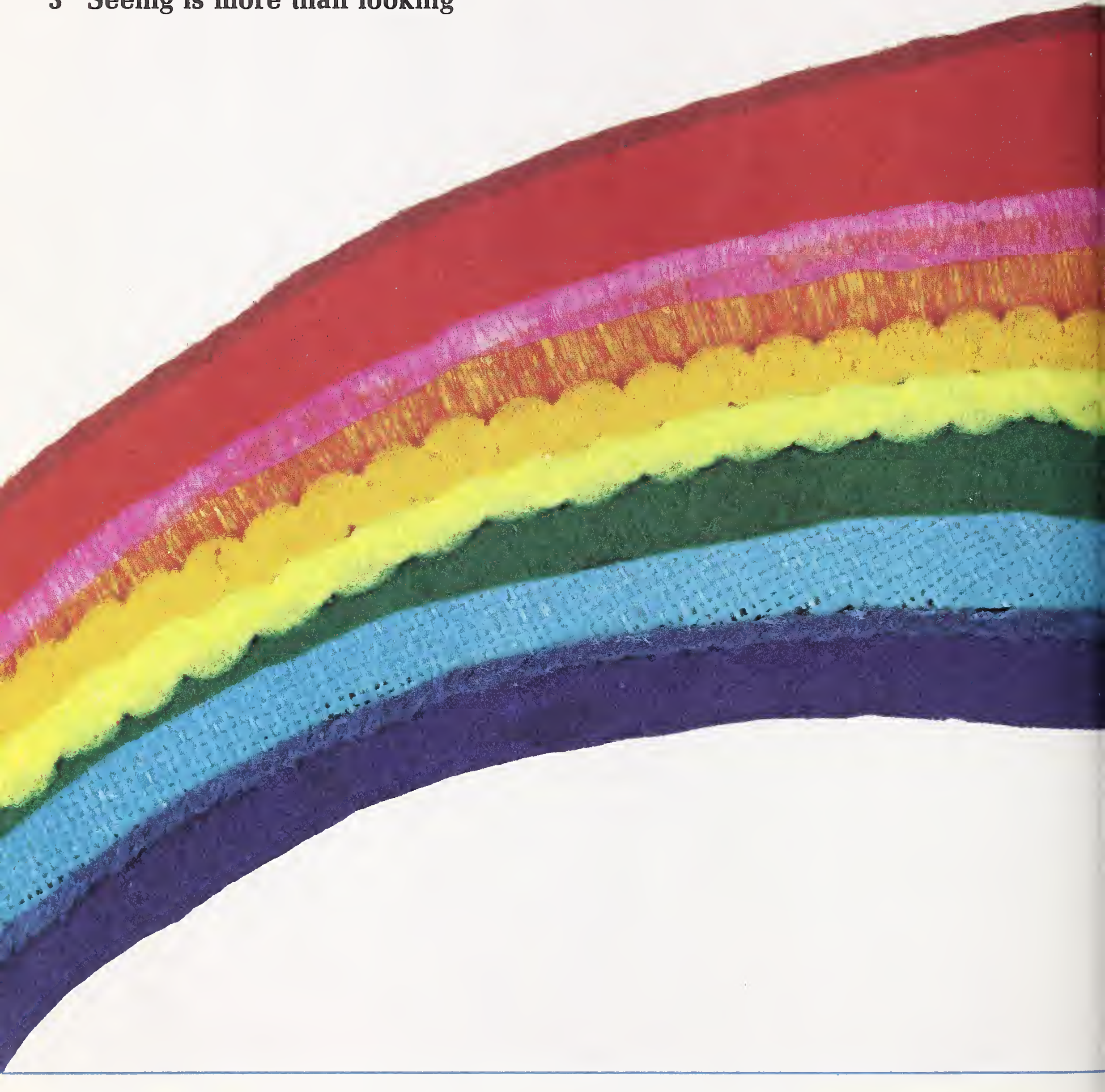
For further involvement: You may wish to use "Having Fun with Science" to involve the pupils in fun activities which reinforce some of the main concepts of the unit "Electricity on the Move." You may also wish to encourage the pupils to make up additional activities related to electricity.

Answers for "What Am I?": [1] A plug. [2] A conductor. [3] A telephone.

Sample answer for "Mystery Answer-board": Each question is wired to its correct answer on the back of the board.

4 Light

1 **Pathways of light**
2 **Colour**
3 **Seeing is more than looking**



Preparing for the unit: For a list of instructional materials helpful in teaching this unit, see pages T13–T14 of the Teacher's Manual. You may also wish to check the list of materials needed for each "Finding Out" activity in this unit and have the pupils begin collecting these materials. These activities are found on pages 151, 152, 155, 157, 161, 163, 167, 171, 173, 176, and 181.

Did you know that a mirror is a funny thing?
It makes everything seem backward.
It can even make my writing seem backward!
what's so funny about that?

Why do you think things seem backward when you see them in a mirror?[1]

What are some things that help you see? How do these things help?[2]

Introducing the unit: You may wish to have the pupils read the cartoon above. Then have the pupils read the questions below the cartoon and discuss their answers to the questions.

Sample answers for questions below the cartoon:

[1] Because the mirror bounces the image of things straight back, which makes the right side of these things appear on the right instead of the left, and the left side of these things appear on the left instead of the right.

[2] Light shines on things and bounces off them to my eyes. My eyes send messages about what I look at to my brain. Then I see things.

1 Pathways of light

Stop for a moment and look around you. As you looked around, you probably saw many things. You were able to see these things for several reasons. But perhaps the most important of these reasons was that light was shining on the things you saw. Where was this light coming from? [1]

If you have ever thought about light, you may know that without it you could not see. You may also know that light comes from many different things. Some light comes from things made by people. For example, traffic lights and flashlights are made by people. However, much of the light around you comes from things that are not made by people. The sun and other stars are such things. When do you think lights made by people are helpful? [2]

[1] **Sample answer:** The sun, a lamp.

[2] **Sample answer:** On a cloudy day, at night, or in a place where the sun cannot shine, such as a mine.

Some living things give off light. Some of these living things, such as this comb jelly, are found in the sea. What other living things do you know of that give off light? Where are they found?

Main concepts of the chapter (pages 146–157):
Light travels in a straight line very fast.
Light cannot pass through things that are opaque.
Light scatters when it passes through things that are translucent.
Light travels straight through or bends when it passes through transparent things.

Performance objectives: After studying the information provided in this chapter, the pupils should be able to
—explain how light travels;
—demonstrate what happens to light when it travels to opaque and transparent things;
—describe what happens when light travels to translucent things.

Important words: light, opaque, translucent, transparent, lenses, image.

Sample answers for the caption: Some squids which are found in the ocean; fireflies which may be seen in many countries during the summer.

Traveling fast

Though many different things give off light, the light from each thing acts in many of the same ways. For instance, all light travels. When light from the sun shines on something, the light travels from the sun to that thing. When you shine a flashlight on something, light from the flashlight travels to that thing. You cannot see light travel because it moves very fast. Do you think it is important that light travels fast? Why or why not?[1]

[1] **Sample answers:** Yes. Because if you had to wait for light to travel to something before you could see, you might have an accident.

For You to Think About

If a thunderstorm is near you, you can see lightning and hear thunder at almost the same time. But when such a storm is far away from you, you can see lightning way before you can hear thunder. Why do you think this is so?

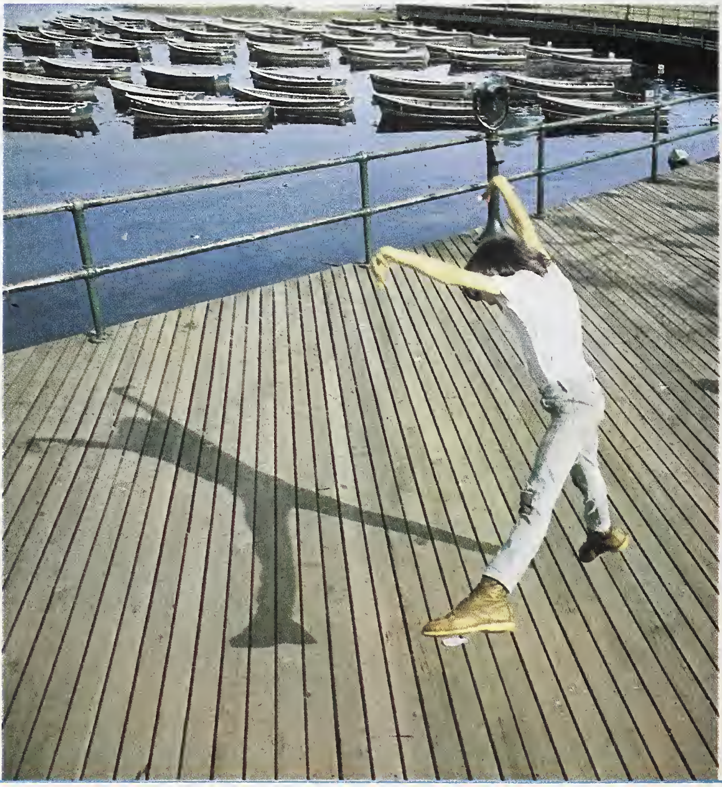
Sample answer for "For You to Think About": Because light travels faster than sound.
Suggested research: After discussing the picture on page 146, you might want to have the pupils find out how some living things give off their own light. Have the pupils look in reference books under the heading *bioluminescence*.

Making shadows

At some time you may have sat in the shadow of a tree or a building. Or you may have watched your shadow as you walked outside on a sunny day. You may even have made shadow pictures on a wall. If you have done any of these things, you know that shadows are places where there is little light. But do you know what causes a shadow? If so, what? [1]

Not only does light travel fast, but it also travels in a straight line. As light travels, it often meets things which it cannot pass through. For example, light cannot pass through a tree trunk. Because light travels in straight lines, it cannot travel around the tree trunk. So, light stops at the tree trunk, leaving a shadow behind it.

[1] **Sample answers:** Yes. Something such as a tree or a building stops light from traveling through to the other side.



Suggested research: After discussing the material on this page, you may wish to point out to the pupils that because light travels in a straight line, many people use light to protect money in banks and to open doors. You might then have the pupils find out how these things are possible. Have the pupils look in reference books under the heading *photoelectric cells.*

Things that light cannot pass through, such as tree trunks, are *opaque* [oh-PAYK]. Some other opaque things are buildings, pencils, and you. What other things are opaque?[1] When do you think it is important to have something that keeps light from passing through it? [2]

[1] **Sample answer:** Books, street signs, buses.

[2] **Sample answer:** When it is a hot day, it is cooler sitting behind something opaque because of its shadow.

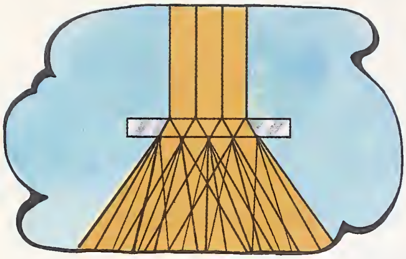
Passing through things

Though there are many things which light cannot pass through, there are some things that it can pass through. What things can you name that light can pass through?[3] How do you know that light can pass through these things? [4]

[3] **Sample answer:** Glass, water.

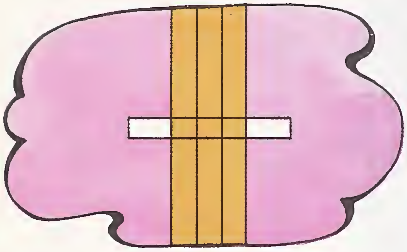
[4] **Sample answer:** I can see light through them.

Suggested activity and discussion: After discussing "Making shadows" on pages 148 and 149, you might want to involve the pupils in an activity which would demonstrate to them that light travels in a straight line. Have the pupils work in groups of two. Have each group cut a 3 cm hole in the centre of two pieces of cardboard. Then have one pupil from each group hold the pieces of cardboard so that the holes open to a wall, but are not exactly in front of each other. Darken the room and have the other pupil from each group shine a flashlight on the first piece of cardboard. You may then wish to ask the following questions: Does the light shine through the holes in each piece of cardboard? If not, why not? (Sample answers: No. Because light travels in a straight line and it cannot travel through the second hole unless that hole is in a straight line with the first hole.)

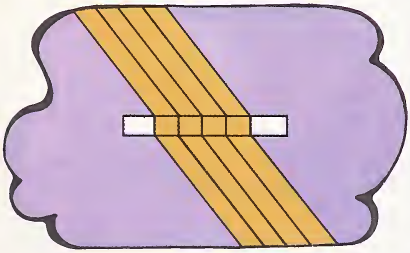


Scattering. When light passes through things, it does not always travel in the same way. For example, when light passes through some things, such as frosted glass, it scatters. That is, the light separates and goes in many directions. If you were to look at this kind of glass, you could see light shining through it. However, you could not see objects very well through the glass.

Things which you cannot see through very well, such as frosted glass, are *translucent* [tran(t)s-LOOS-uhnt]. Thin cloth and thin paper are also such things. When do you think it is important to have something that scatters light?[1]



Passing straight through. Light can pass through some things in another way. It can pass straight through these things. Such things are *transparent*. Some transparent things are clear glass, air, and water. Because light can pass straight through transparent things, you can see through them clearly. What other transparent things can you think of?[2] When might you want to be able to see through something?[3]



Bending. Though light can pass straight through transparent things, it sometimes bends as it passes through such things. Generally, this bending takes place when light travels into these things at a slant. The light bends when it travels from one thing to another at a slant because it changes speed. For instance, when light travels from air into water at a slant, the light bends because it slows down when it meets the water. Light also slows down and bends when it travels from water into glass at a slant. The bottom picture on this page shows light being bent. Where does the light bend?[4]

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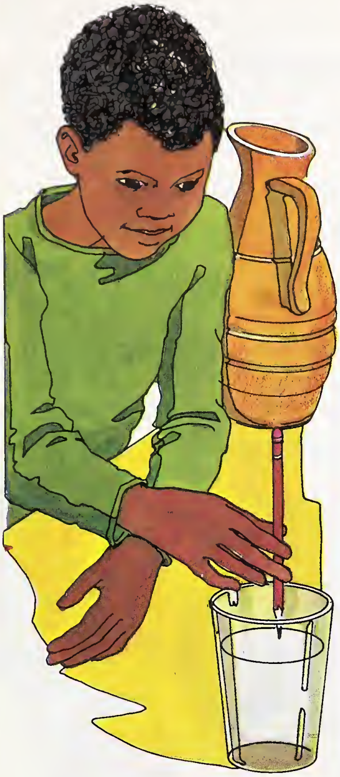
[1] **Sample answer:** When I need light to shine into a room, but when I do not need to see out.

[2] **Sample answer:** Cellophane, plastic wrap.

[3] **Sample answer:** When something is wrapped in plastic wrap, I might want to see what it is. When I am inside a room, I might want to look outside.

[4] **Sample answer:** It bends where it enters the object and where it leaves the object.

Suggested activity and discussion: After discussing "Bending" on this page, you may wish to put a coin in a pan and have the pupils stand so that the coin is below the rim of the pan and just out of their sight. Then pour water into the pan until the pupils can see the coin. You might then ask the pupils this question: Why can you see the coin now? (Sample answer: Because the water bends the light so that it makes the coin seem to rise in the pan.)



FINDING OUT

How can you show what happens to light when it travels from air into water?

You will need: pencil, drinking glass

- Fill the glass two-thirds full with water.
- Put the glass in front of you on a table.
- Place the pencil in the water. Hold the pencil straight up.
- Look through the glass at the pencil.
- Draw what you see.

Did the pencil look straight or bent?

- Lean the pencil against the inside of the glass.
- Look through the glass at the pencil. Draw what you see.
- Compare your drawings.

Did the pencil look different in each drawing? If so, why?
Try moving the pencil to other parts of the glass.
How did the pencil look different in other parts of the glass?

Light also bends when it passes through things that are curved. Many of these things are called *lenses*. A drop of water may be a lens. Glass or plastic is often used to make special lenses. What things do you know of that have lenses in them? [1]

[1] **Sample answer:** Eyeglasses, telescopes.

Teaching helps for "Finding Out":
Processes used: observing, comparing, inferring. *Sample findings:* When the pupils first look at the pencil, they will most likely say that it looks straight. After they lean the pencil against the glass and look at the pencil, they will most likely say that the pencil looks bent. After comparing their drawings, the pupils will probably infer that the light shining on the pencil bends as it enters the water at a slant, causing the pencil to look bent. After moving the pencil to other parts of the glass, the pupils will most likely discover that light bends whenever it enters water at a slant.

FINDING OUT

How can you make a water-drop lens?

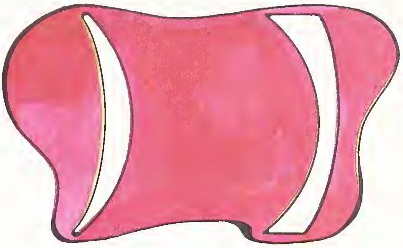
You will need: thin piece of wire, large nail, newspaper

- Make a loop around the nail with the wire.
- Dip the wire into some water to catch a drop of water in the loop.
- When you have a drop of water in the loop, hold the wire over the newspaper.
- Look at the newspaper without the loop. Then look through the loop at the newspaper.

How did the paper look different through your lens? What does this tell you about the way a drop of water bends light? Try looking at other things through the lens.

Teaching helps for "Finding Out":
Processes used: observing, comparing, inferring. *Sample findings:* The pupils will most likely see that the letters on the paper look larger through their lens than they do normally. The pupils may then infer that a drop of water bends light in a way that makes things look larger than they are.

There are many kinds of lenses. Perhaps the kind of lens used most often is the *convex lens*. This kind is thick at the middle and thin at the edges. Convex lenses can bend light in a way that makes things look larger and closer than they are. For this reason, convex lenses are used in magnifying glasses and telescopes. In what other things might convex lenses be used? [1]



[1] **Sample answer:** Microscopes, binoculars.

Two kinds of lenses used in eyeglasses are shown at the right. The girl below is using a magnifying glass. When might you find looking through a magnifying glass helpful?

Sample answer for the caption: When I want to see something very small, a magnifying glass will make it look bigger so that it is easier to see. **Suggested research:** After discussing "Bending" on pages 150, 151, and 153, you may wish to point out to the pupils that concave lenses are also called converging lenses because they make light converge, or come together. The lens shown at the top left is such a lens. You may also want to point out that there are other lenses that are called diverging lenses. These lenses make light diverge, or spread out. The lens shown at the top right is such a lens. Then you might have the pupils try to find out what diverging lenses are used for other than some eyeglasses.

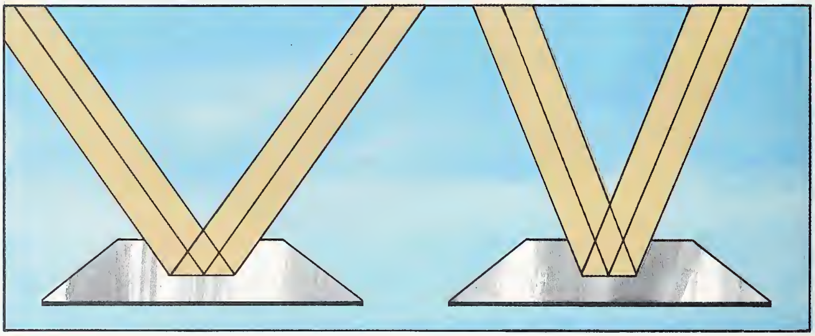
Bouncing light

Have you ever thrown a rubber ball at something? If you have, you know that when the ball hits most things, it bounces off them. Like a rubber ball, light bounces off most things it hits.

When light travels to something opaque, all the light does not stop. Some of this light bounces off. When light travels to something translucent or transparent, all the light does not pass through. Some of this light bounces off. When light bounces off things and travels to your eyes, you are able to see.

Bouncing at different angles. If you have ever thrown a rubber ball at a wall, you know something about how a ball bounces. That is, a ball does not always bounce off a wall at the same angle, or slant. Sometimes when you throw a ball at a wall, the ball bounces straight back to you. But at other times, the ball bounces to either side of you. Why do you think the ball bounces at an angle?[1]

Light also bounces at different angles. The pictures below show light bouncing. From what angle is the light traveling to each thing?[2] How is that angle like the angle the light bounces off each thing?[3]



[1] **Sample answer:** Because the ball is thrown at the wall at an angle, or because the ball hits an uneven part of the wall.

[2] **Sample answer:** From about 45° in the first picture and about 60° in the second picture.

[3] **Sample answer:** It is the same, but on the opposite side.

FINDING OUT

How is the angle light travels to something like the angle light bounces off it?

You will need: flat mirror, comb, flashlight, cardboard

- Hold the comb as shown.
- Shine the flashlight on the comb so that light travels through the teeth and falls on the cardboard.
- Place the mirror so that it is facing the comb.

What happened to the light when it met the mirror?

- Slowly turn the mirror so that it is facing away from the comb.

What happened to the light? How was the angle the light traveled to the mirror like the angle the light bounced off the mirror?

Bouncing a picture. When you look at something, light shining on your face bounces in a pattern to that thing. If the thing you are looking at is smooth and shiny, the light bounces off that thing in the same pattern to your eyes. Then you see an *image*, or picture, of your face. However, if the thing you are looking at is rough and dull, the light scatters so that no image is formed. What are some things you have looked at and seen your image?[1] What are some things you have looked at and not seen your image? [2]

[1] **Sample answer:** Mirrors, water of a lake, glass.

[2] **Sample answer:** Books, walls, ground.

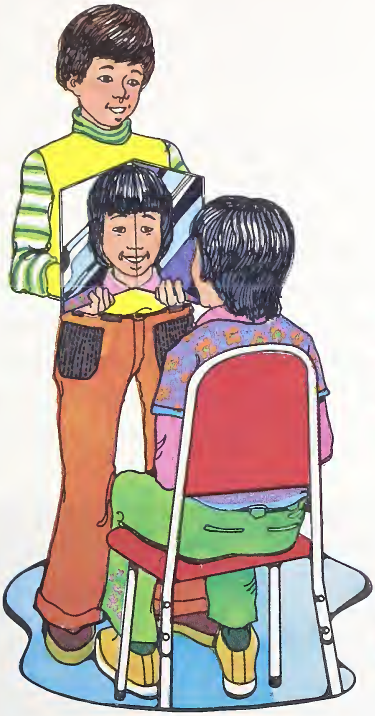
Teaching helps for "Finding Out":
Processes used: observing, inferring.
Sample findings: The pupils will most likely see that when the light meets the mirror, it is bounced back toward the comb, causing a shadow on the side of the comb nearer the flashlight. As they turn the mirror, they will see that the mirror bounces a shadow of the comb and that the angle of this shadow leading away from the mirror changes as the angle the light shines on the mirror changes. The pupils may then infer that the angle the light travels to the mirror is the same as the angle the light bounces off the mirror.

For You to Think About

Sometimes when you look in a mirror, you cannot see an image of yourself, but you can see the image of other people. These people can see your image, but cannot see their own image. How can this be so?

You have most likely noticed that the image of your face which you see in a mirror is different from the way other people see your face. When other people see your face, light from the right side of your face bounces on their left side. So, other people see your right side on their left. Light from the left side of your face bounces on other people's right side. So, they see your left side on their right. But when you look in a mirror, light from the right side of your face bounces back on your right. Light from the left side of your face bounces back on your left. As a result, the image of your face in the mirror is the opposite of the way other people see your face!

Sample answer for "For You to Think About": Light bounces off a mirror at the same angle that it strikes the mirror. Therefore, if I stand at an angle to one side of the front of a mirror, I cannot see myself, but I can see people standing at the same angle to the other side of the front of the mirror.



FINDING OUT

How can you see yourself as others see you?

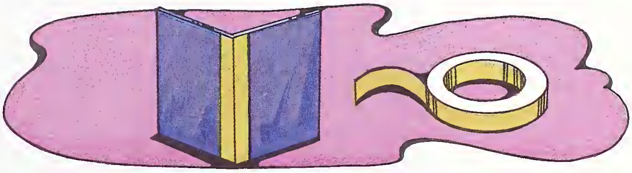
You will need: 2 large flat mirrors, tape

- Look in one of the mirrors. Wink your right eye.

Which eye of the image winked? The right? The left?

- Have someone hold the mirrors as shown.
- Look in these mirrors so that your whole face is showing in the mirrors.
- Wink your right eye.

Which eye of the image winked? Why?
How else can you see yourself as others see you?



A Second Look

1. Why can't you see light travel?
2. What causes a shadow?
3. What happens when light passes through transparent things? Translucent things?
4. Why can you see yourself better when you look at some things than at others?

Teaching helps for "Finding Out": *Processes used:* observing, comparing, inferring. *Sample findings:* The pupils will probably see the left eye wink first and then the right eye wink. They may infer that they see their right eye wink because the mirrors are held at a slant, which causes light from their right side to bounce from the mirror on their right to the mirror on their left, and then to their left side. The pupils may see how others see them from photographs.

Sample answers for "A Second Look": 1. Because light travels very fast. 2. Something opaque stops light, leaving a shadow behind it. 3. It goes straight through transparent things or bends. It scatters as it passes through translucent things. 4. I can see myself better when I look at things that bounce light in the same pattern as it shines on them than I can when I look at things that scatter light when it bounces from them.

2 Colour

If someone were to say the word *colour* to you, what would you think about? Would you think about your favourite colour? Would you think about your least favourite colour? Would you think about colour television or colour movies? What else would you think about? 1

Most people would agree that colour is very important in their life. Colour makes many things, such as flowers and paintings, look beautiful. Colour makes many things, such as movies and television, fun to see. Colour even helps keep people safe. For example, colour on traffic lights helps people to be careful when they are driving. Bright-coloured clothing on bicycle riders makes it easier for car drivers to see them. What are some other reasons why colour is important? 2

[1] **Sample answer:** Paintings, neon signs, photographs.

[2] **Sample answer:** Colour helps people know what things belong to them, and colour helps people find things.

In what ways might colour help keep the children in this picture safe?

Main concepts of the chapter (pages 158-167):
White light is made up of many colours.
Light and pigments give things colour.
Coloured light may cause things to look a different colour than they look in white light.

Performance objectives: After studying the information provided in this chapter, the pupils should be able to
- —explain what makes up white light;
- —describe how light and pigments give things colour;
- —show that coloured light may cause things to look a different colour than they look in white light.

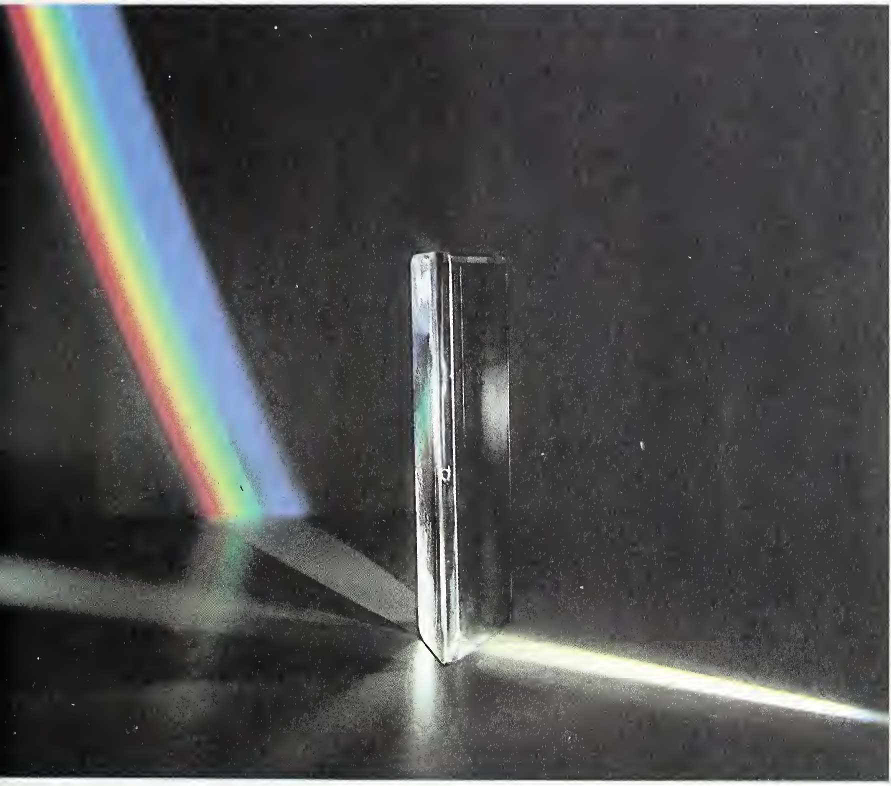
Important words: colour, prism, spectrum, pigments.

Sample answer for the caption: The colours these children are wearing are bright and easy to see. These colours help car drivers see the children.

Colour in light

For many years, people thought that things looked colourful because they had colour in them. Around 1700, however, an Englishman named Sir Isaac Newton proved that things look colourful because of the way light bounces off them. But in order to understand this, it is important to know something about what makes up light.

Colour in sunlight. Newton held a piece of glass called a *prism* [PRIHZ-uhm] up to a window through which sunlight was shining. (Sunlight is often thought of as white light.) As he did this, he looked across the room. There he saw that the prisim had bent the light into seven parts. Each part was a different colour.



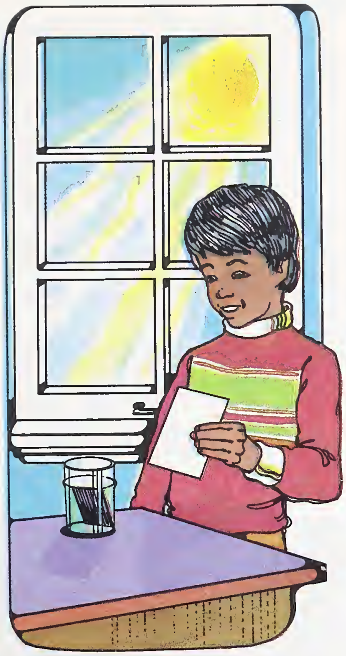
Suggested activity: If you have access to a prism or some cut glass, you may wish to have the pupils observe sunlight being bent into colours. Have the pupils hold the prism up to a window through which sunlight is shining. You might then have the pupils make a list of the colours they find.

Then Newton held another prism in the path of the light which traveled from the first prisim. When he looked across the room, he no longer saw the seven colours. Newton found that the second prism had bent the light so that the colours mixed together. When the colours mixed, they formed white light. It was then that Newton knew that sunlight is made up of many colours.

The seven colours Newton found made up a band of side-by-side colours. This band is called a *spectrum*. The colours of the spectrum are red, orange, yellow, green, blue, indigo, and violet. Have you ever seen a spectrum? If so, where? [1]

[1] **Sample answers:** Yes. When light shone through cut glass in a chandelier.

Suggested activity: After discussing the material on this page, you may wish to point out to the pupils that green light, blue light, and red light are the three primary colours of light. That is, they each make up one third of the spectrum, and when added together, form white light. You might then want to have the pupils cut a small circle out of cardboard, divide the circle into three equal parts, and colour one part red, one part green, and one part blue. Next, have the pupils poke a pin through the centre of the bottom of the circle, stick the pin in the eraser of a pencil, and spin the circle. Have the pupils discuss their observations.



FINDING OUT

How can you make your own prism?

You will need: small flat mirror, glass of water, white piece of paper

- Place the mirror in the glass of water as pictured.
- Put the glass in the sunlight so that the mirror faces the sun.
- Put the paper at a slant in front of the glass.
- Move the paper until you can see the colours clearly.

What colours did you see? Why could you see them?

- Tap the glass lightly.

What happened to the colours? Why?

Though Newton used a prism to show that sunlight is made up of colour, other things can show a spectrum as well. Water is such a thing. When water is sprayed from a hose in the sunlight, the water bends the light. When this happens, you might see a spectrum. Things with close ridges, such as records, can also show a spectrum. The ridges may separate sunlight into colours. What other things might show a spectrum?[1]

Color in other kinds of white light. Today, it is known that sunlight is not the only kind of white light that is

[1] **Sample answer:** Diamonds, oily puddles.

Teaching helps for "Finding Out":
Processes used: observing, inferring.
Sample findings: The pupils will most likely see several colours of the spectrum. These include red, orange, yellow, green, blue, indigo, and violet. The pupils may infer that the water and the mirror in the glass act as a prism and bend the sunlight into a spectrum. After tapping the glass lightly, the pupils will most likely see the spectrum move. They will probably infer that tapping the glass causes the water to move, which moves the spectrum.

made up of many colours. It has been found that all white light is made up of many colours.

However, different kinds of white light are made up of different amounts of the colours of the spectrum. Sunlight is made up of almost equal amounts of each colour of the spectrum. But light from a bulb may not be. Light from the bulbs in the picture below on the left is made up of more red and orange than the other colours. Light from bulbs such as the ones in the picture below on the right is made up of more blue and yellow than red and violet.

Why might it be important to know that different kinds of light are made up of different amounts of colour?[1]

[1] **Sample answer:** Because things you buy in a store may look a different colour at home where you have a different kind of light.

Suggested research: After discussing "Colour in other kinds of white light" on pages 161 and 162, you might want to have the pupils find out what causes the white light from different kinds of bulbs to be made up of different amounts of colour. The pupils might look in reference books under the heading *electric light.*

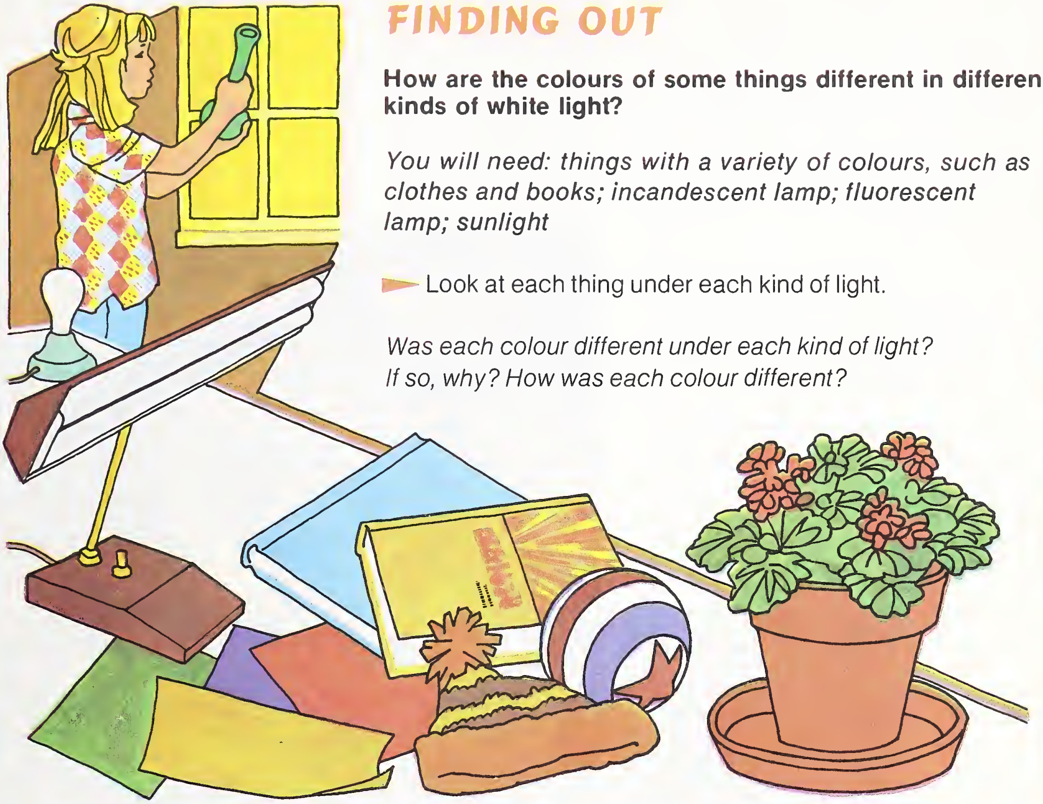
FINDING OUT

How are the colours of some things different in different kinds of white light?

You will need: things with a variety of colours, such as clothes and books; incandescent lamp; fluorescent lamp; sunlight

Look at each thing under each kind of light.

Was each colour different under each kind of light? If so, why? How was each colour different?



The colour of things in sunlight

As stated before, you see the colour of things because of the way light bounces off them. Suppose you looked at a car in the sunlight. If the car looked white, all the colours of the sunlight would be bouncing to your eyes. But if the car looked black, none of the colours would

Teaching helps for "Finding Out":
Processes used: observing, comparing, inferring. *Sample findings:* After looking at each thing under each kind of light, the pupils will probably observe that most of the colours were different under each kind of light. The pupils will then most likely infer that the reason for this is that each kind of light is made up of different amounts of the colours of the spectrum. The pupils may find that under the incandescent lamp, some colours look redder than they do under sunlight, and under the fluorescent lamp, some colours look bluer than they do under sunlight.

be bouncing. All the colours would be "soaked up" by certain things in the paint of the car. These things are called *pigments*. Pigments are found in almost everything on earth. What do you think happens to the light from something that looks red? [1] What happens to the light from something that looks blue? [2]

You have probably noticed that when you look at many things, you see colours that are not in the spectrum. Some of these colours are purple, brown, and turquoise. Such colours are formed when several of the colours of the spectrum are mixed together. When something looks purple, pigments in it soak up all the colours of light except red, blue, and violet. These colours in light mix as they bounce to your eyes. What other colours do you know of that are not in the spectrum? [3]

Exploring on Your Own

During hot weather, most people wear clothing of lighter colours, such as white and yellow. But during cold weather, most people wear clothing of darker colours, such as brown and blue. See if you can find out why.

[1] **Sample answer:** Pigments in the object soak up all the colours of light except red, and the red part of light bounces to my eyes.

[2] **Sample answer:** Pigments in the object soak up all the colours of light except blue, and the blue part of light bounces to my eyes.

[3] **Sample answer:** Pink, silver, gold.

Sample findings for "Exploring on Your Own": The pigments in something white or yellow bounce all or almost all the colours in sunlight. The pigments in something brown or blue soak up many of the colours in sunlight. Because light from the sun contains heat, lighter clothing bounces more heat than darker clothing and is therefore cooler to wear than darker clothing.

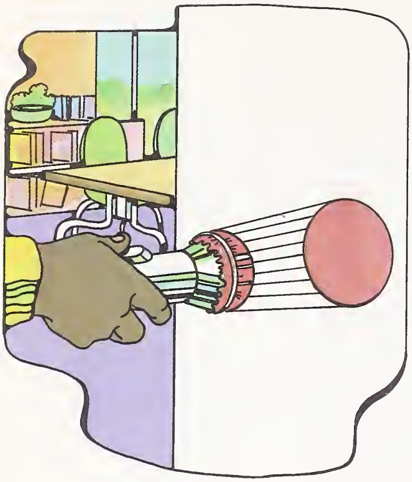
The changing colour of the sky

Most things you see keep their same colour in sunlight. There is one thing, however, that often changes colour in sunlight. That is the sky.

The sky is made up of many things. Some of these things are dust, gases, and water. These things slow sunlight down as it travels to the earth. As sunlight slows down, it scatters. Most times, the blue part of sunlight scatters more than the other colours. Because of this, the blue light covers up the other colours. So, the sky looks blue.

At sunrise and sunset, the red part of sunlight may scatter more than the other colours. At these times the sun is low in the sky. Because of this, light must travel through more of the sky. When astronauts travel high above the earth, the sky around them looks black. Why do you think this is so? [1]

[1] **Sample answer:** Because there are no gases, dust, or water to bounce the colours of sunlight.



The colour of things in coloured light

Generally, you look at things when white light is shining on them. But sometimes light of a different colour shines on things. Coloured light may cause things to look a different colour than they look in white light.

When you shine a red light on a wall that looks white in white light, the wall looks red. The red light has none of the other colours of white light. So, the pigments in the paint on the wall can only bounce red.

Suppose you were to shine a red light on a leaf that looks green in white light. The leaf would look black. The pigments in the leaf soak up the red light. Because there is no green in the red light, the pigments in the leaf can bounce no colour. What colour do you think something would look in red light if it looks red in white light? Why?[1]

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[1] **Sample answers:** Red. Because the pigments in it could still bounce light.

Suggested discussion and activity: After discussing "The colour of things in coloured light," you may wish to involve the pupils in an activity which would help them discover how mixing colours in light is different from mixing colours in paint. Have the pupils tape some green cellophane to a flashlight, some red cellophane to a flashlight, and some blue cellophane to a flashlight. Then have the pupils shine the three flashlights on the same place on something white. Next have the pupils mix green, red, and blue paint together. You might then ask the pupils these questions: What happened when you mixed the colours of light together? Why? (Sample answers: They formed white light. Because these three colours make up all the colours of the spectrum.) What happened when you mixed the colours of paint together? Why? (Sample answers: They formed black. Because the pigments in these colours soak up all the colours of light so that no colours are bounced.)

FINDING OUT

What colour do some things seem to be in coloured light?

You will need: flashlight; piece of green, red, or blue cellophane; tape; variety of colourful things, such as books, marbles, and coloured paper

- Tape the cellophane over the end of the flashlight as pictured.
- In a dark room, shine the flashlight on each thing.
- Have some people write down what colours they see when each thing is shown.
- Then have the people write down what colours they think the things would be in white light.
- Take the cellophane off the flashlight.
- Shine the flashlight on the things.

How many people guessed the colours of each thing?

A Second Look

1. How do light and pigments give things colour?
2. Why does the sky change colour?
3. Why might something look a different colour in coloured light?

Teaching helps for "Finding Out":
Processes used: observing, predicting.
Sample findings: The pupils will most likely find that they can easily guess the colour of things that are the same colour as the cellophane. For instance, the pupils will probably guess which things are green if green cellophane is used. However, the pupils will most likely find it difficult to guess which things are blue or red under green light because these things will look black.

Sample answers for "A Second Look": 1. When light shines on something, the pigments in it soak up certain colours of the light and bounce other colours to my eyes. 2. The sky changes colour because different colours of sunlight are scattered by parts of the sky at different times. The colours scattered most cover the other colours. 3. It may contain pigments which soak up the colour in this light and bounce no colour, making the thing look black.

3 Seeing is more than looking

Have you ever tried to walk across a room when your eyes were closed? If you have, you know that being able to see is important when you are trying to find your way. You may also know that there are many more reasons why being able to see is important. For instance, being able to see may help you learn about things. Being able to see may help you keep safe. Being able to see may even help you understand people. What are some things you have learned because you were able to see?[1] What are some ways being able to see has helped you keep safe or understand people?[2] What are some other reasons why being able to see is important?[3]

[1] **Sample answer:** How to identify things, how to read, how to watch things such as football games.

[2] **Sample answers:** I have looked for cars before crossing a street. I have looked for things that might trip me before I have gone upstairs. I have been able to tell by looking at some people's face when they were happy or angry or sad.

[3] **Sample answer:** To do many jobs, to write, to see where I am going.

Main concepts of the chapter (pages 168–187):
Seeing is important to you in many ways.
Two eyes help you see better than one eye.
Many people have problems in seeing. Some of these problems can be corrected.
Many problems in seeing can be prevented by knowing how to take care of your eyes.

Performance objectives: After studying the information provided in this chapter, the pupils should be able to

—state at least three ways in which seeing is important;
—give two reasons why two eyes are more helpful to them than one eye;
—name three problems in seeing, and if these problems can be corrected, state how;
—list some of the things they can do to take care of their eyes.

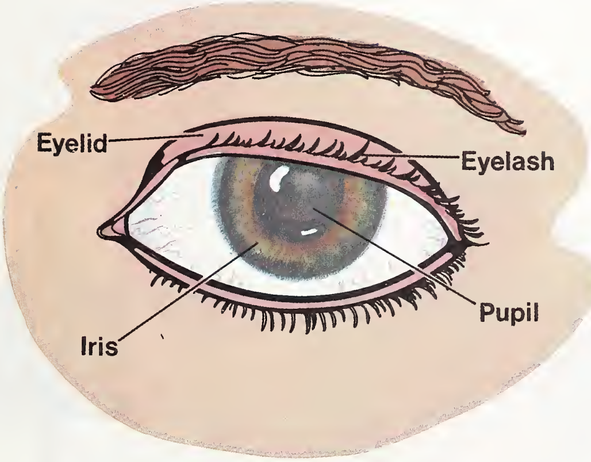
Important words: cornea, pupil, iris, lens, retina, optic nerve, nearsighted, farsighted, blindness.

Seeing the light

As said before, you see things because light bounces off them to your eyes. However, when light reaches your eyes, several things must happen so that you can see. The first of these is that light must pass through a transparent part of each eye called the *cornea* [KAWR-nee-uh]. The cornea is curved and bends light inward. The light is bent even further as it passes through a liquid behind the cornea.

Next, light passes through an opening in each eye. This opening is known as the *pupil*. It looks like a black spot in the middle of the coloured part of each eye. This coloured part, called the *iris*, makes the pupil change size in different amounts of light. For example, when the light is bright, the iris makes the pupil small. When the light is dim, the iris makes the pupil large. Why might it be important that the pupil change size in different amounts of light? [1]

[1] **Sample answer:** So that the right amount of light for seeing can enter the eye at all times.



How are your eyelids and eyelashes helpful to you?

Suggested activity: After discussing the material on this page, you may wish to involve the class in an activity which would help them see that the pupils of their eyes change size. Have each person roll a dark-coloured piece of paper into a tube and hold the tube on a printed page of a book. Then have them close one eye and look through the tube while making sure that no light can be seen in the tube. After a few minutes, each person will be able to see the print on the page clearly. At this time, have each person look quickly at a mirror to watch the pupils of their eyes change size in the brighter light of the classroom.

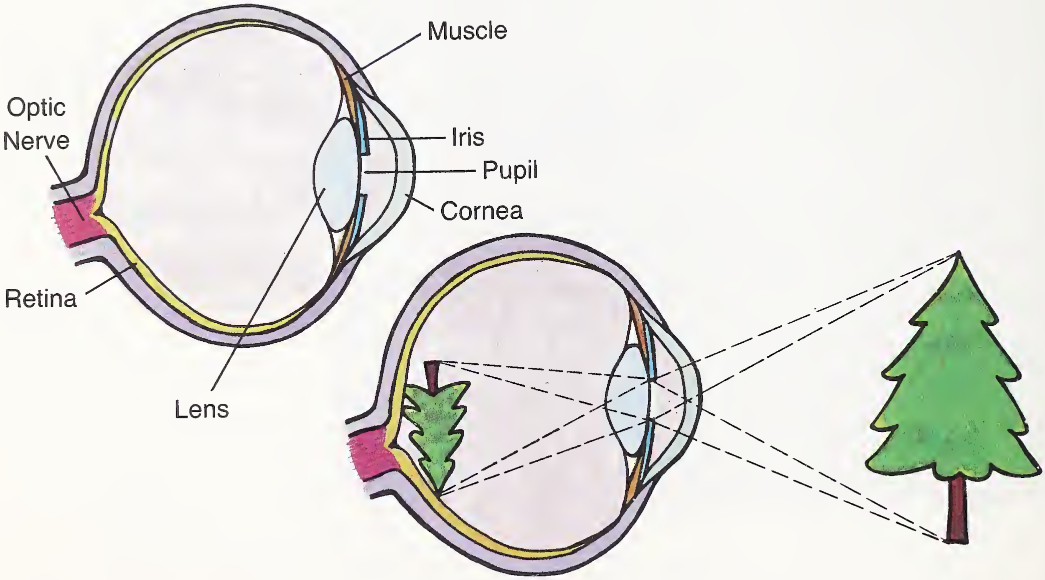
Sample answers for the caption: They help protect my eyes from injury. When I blink, my eyelids help clean my eyes. When I squint, my eyelids help keep too much light from entering my eyes. My eyelashes help keep things such as dust out of my eyes.

Once light passes through the pupil, the light enters a part of each eye known as the *lens*. Like other kinds of lenses, the lens of each eye bends light. Muscles at the sides of the lens change its shape so that it can bend light in two ways. One way lets you see nearby things clearly. The other way lets you see faraway things clearly.

After the light passes through the lens, the light is bent still further. This bending takes place in a jellylike matter inside each eye. This matter also helps your eyes keep their shape. Why do you think it is important for your eyes to keep their shape? [1]

Finally, the light forms an image on part of the inside wall of each eye. This wall is called the *retina* [REHT-uhn-uh]. The retina is made up of millions of special cells. These cells send messages about the image to your brain. These messages travel along a nerve called the *optic nerve*. Once the messages reach your brain, you are able to see.

The lens of each eye bends light so that the images of things you look at form upside down on the retina. But your brain "reads" the messages about the images in a way that lets you see things right side up.



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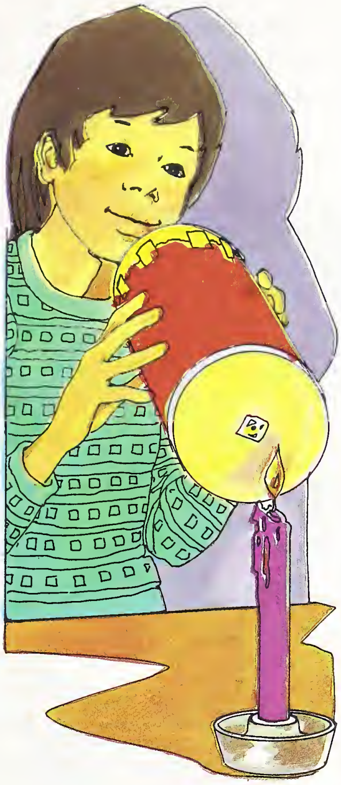
[1] **Sample answer:** So that light can enter them and bend properly for seeing clearly.

Suggested discussion: You may wish to use the picture above as an aid in teaching the pupils about the way light is bent in the eye. First have the pupils read and discuss "Seeing the light" on pages 169 and 170. Then have the pupils trace the path of the light from the tree being looked at.



FINDING OUT

How can you show the way light shines an image on your retina?

You will need: round cereal box, scissors, tissue paper, tape, tinfoil, candle, pin, things such as pencils and matchbook

- Cut a hole about 3 cm square in the bottom of the box.
- Tape tinfoil over the hole. With the pin, poke a tiny hole in the center of the foil.
- Tape some tissue paper tightly over the top of the box. Make sure the paper is smooth.
- Light the candle. Place the candle in front of the tiny hole in a dark room as pictured.
- Look at the paper end of the box.

What did you see? (*It helps to darken the room.*) *How does this show how light shines an image on your retina?*

- Let light shine through a window in the room.
- Hold the foil end of the box toward the window.
- Then, hold things other than the candle in front of the hole.

What did you see?

Seeing with two eyes

Since both your eyes work in the same way, you could get along well with only one eye. However, two eyes are better than one. One reason for this is that two eyes help you see more of something.

Teaching helps for "Finding Out":
Processes used: observing, inferring.
Sample findings: The pupils will most likely find that an upside-down image of the candle and of other things appears on the paper end of the box. The pupils may infer that when they look at things, light forms an upside-down image of these things on their retinas.

Additional information: Because the hole in the tinfoil is very tiny, light from the objects being looked at must travel into the hole at a slant. Therefore, light from the top of these objects travels toward the bottom of the inside of the box, and light from the bottom of the objects travels toward the top of the inside of the box, thus producing an upside-down image.

[1] **Sample answer:** The front half.

[2] **Sample answer:** Part of the side and part of the front.

[3] **Sample answer:** The front and part of the side.

Stop for a moment and hold a finger up in front of you. Look at your finger with your right eye closed. How much of your finger did you see?[1] Look at your finger with your left eye closed. How much of your finger did you see?[2] Now look at your finger with both eyes. How much of your finger did you see?[3]

Each of your eyes looks at things, such as your finger, from a different angle. Therefore, each eye sends messages about a different image to your brain. Your brain blends these messages so that you see only one image. But you see more of your finger.

Two eyes also help you see more things around you. You may have noticed that when you look straight at something, you see it clearly. But you also see things at the sides of what you are looking at. Though you do not see things at the sides clearly, you may be aware that they are there. Why is it helpful to you to be aware of things at the side of you?[4]

[4] **Sample answer:** So that I avoid something that may be coming at me from the side, such as a ball or a car.

Suggested activity and discussion: At this time, you may wish to involve the pupils in an activity which would help them discover that their brain blends the messages about the different images seen by their eyes so that only one image is seen. Have the pupils hold up a finger in front of them and look past their finger at something across the room. You might then want to ask the pupils these questions: Can you see your finger when you look across the room? If so, what does it look like and why does it look this way? (Sample answers: Yes. It looks like two fingers, because each eye is sending messages about an image of my finger to my brain. These messages are not being blended by my brain because it is blending the messages about what I am actually looking at across the room.)

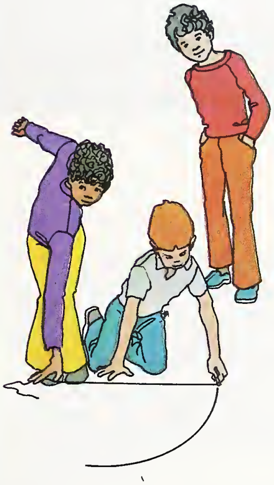
FINDING OUT

How far around you can you see?

You will need: pencil; string; piece of chalk; things such as matchbook, eraser, and rubber ball

- Tie one end of the string around the chalk. Give someone the chalk and string. Give someone else the pencil.
- Stand on a sidewalk. Look straight ahead of you.
- Have the person with the pencil stand behind you and hold it as shown. Then have that person move slowly toward one side of you.
- When you can see movement out of the corner of your eye, have that person stop.
- Have the other person use the chalk to make a mark on the sidewalk below the pencil.
- Have the person with the pencil move slowly toward the other side of you until you can see movement.
- Have the spot marked.
- Next, hold the loose end of the string on the toe of your shoe. Have someone draw a line in front of you from each chalk mark with the chalk end of the string. You should see part of a circle.

How far around you could you see? Could you see the pencil clearly when you first saw it? Why or why not?



- Now have someone move from behind you to each side of you several times. The person should hold a different thing each time.
- Have that person stop when you can see each thing clearly.
- Have someone mark the spot you saw each thing.
- Make a line with the string and chalk as before.

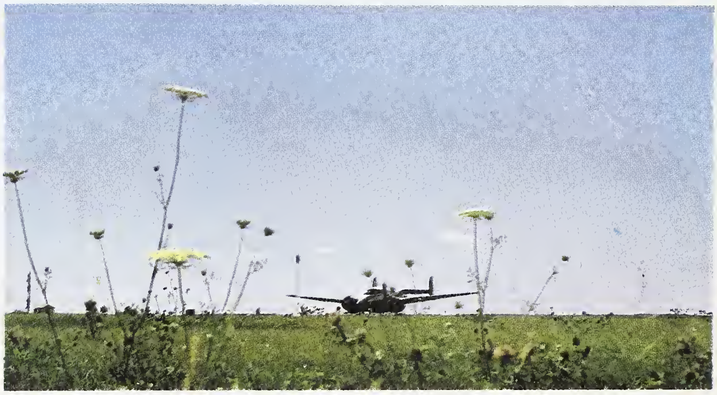
How far around you could you see things clearly?

Teaching helps for "Finding Out":
Processes used: observing, inferring, communicating.
Sample findings: The pupils will most likely find that they can see things more than halfway around them. But they cannot see things clearly at the side of them until these things are closer to the front of their body. They may infer that to see something clearly, light from the object must strike the center of their retinas. Therefore, the pupils must look directly at something to see it clearly.

Seeing some interesting things

Generally, the things you see are easy to understand. For example, when you see a tree nearby, you understand that it is a tree. The reason for this is that you have seen trees before. You know that trees are certain shapes and colours. When you see the tree from far away, you understand that it has not become smaller. Why is this so?[1]

[1] **Sample answer:** Because I have learned that things that are far away from me look smaller than they do when close to me.



Why do you think the flowers in this picture look bigger than the airplane?

Though most of the things you see are easy to understand, some things seem to play tricks on you. Have you ever seen anything that seemed to play a trick on you? If so, what was it? Why do you think it seemed to play a trick?[2]

[2] **Sample answers:** Yes. I saw water on a road. Because there was no water there.

Seeing things that are not there. One thing you may see that seems to play a trick on you is called an *afterimage.* An afterimage is something you see that is not really there. After you stare at bright colours, you may see an afterimage. For instance, suppose you stared

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Sample answer for the caption: Because the flowers are closer than the airplane.

Suggested activity: After discussing the material on this page, you may wish to involve the pupils in an activity in which they would see something that is not there. Have the pupils cut a small circle out of cardboard. Then have the pupils fill half the circle with black ink. In the white half, have the pupils draw three short, curved, thin lines in black ink close to the edge of the circle. Below and to the right of these lines, have the pupils draw three similar lines. Below and to the right of these lines, have the pupils draw three more lines leading into the black half. Next, have the pupils stick a pin through the center of the circle, stick the pin in the eraser of a pencil, and spin the circle. The pupils should see colour as they spin the circle.

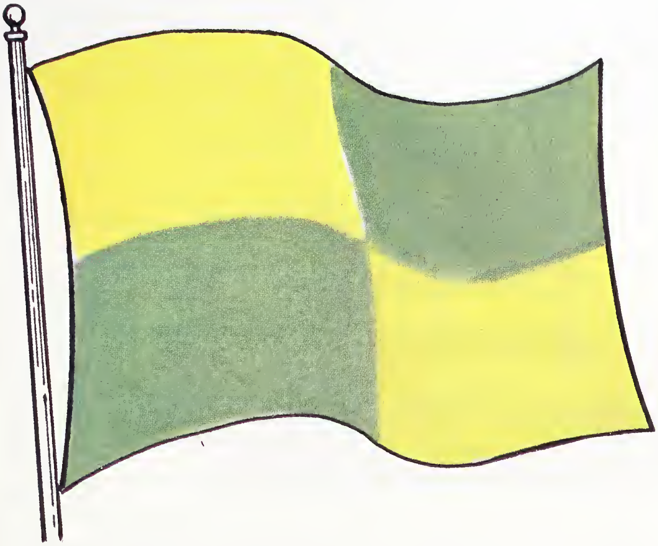
at a bright-coloured circle for about a minute. If you then looked at a white piece of paper, you would see an image of the circle. But the image of the circle would be a different colour from the circle you looked at!

When you look at a bright colour, such as red, certain cells in your retinas become tired. These cells send weak messages to your brain. If you look at something white after you look at something red, these cells cannot send messages about the red part of white. Therefore, you see the colour that mixes with red to form white. That colour is green.

Any two colours of light that form white when they are mixed are called *complementary colours*. If you were to stare at the flag below and then look at white paper, you would see the complementary colours of green and yellow. Try it!

Exploring on Your Own

Along with afterimages, some other things you may see that are not really there are called *mirages*. On a hot day, people who are riding in a car may see a mirage. This mirage may look like water on the road. See if you can find out what causes a mirage.



Teaching helps for the picture above: To get the best results from the activity involving the picture above, tell the pupils to stare at the flag for at least one minute under bright light. The afterimage is best seen in dim light. The complementary colours of green and yellow are red and blue. You may then want to have the pupils draw other pictures which might cause an afterimage.

Sample findings for "Exploring on Your Own": Hot air near the surface of the earth bends the light from the sky to your eyes. Then you see an image of the sky on the road. If there is a cloud in the sky, the image of the cloud looks like water. The "water" may look like it has ripples because the hot air is moving.

Seeing still things move. Have you ever looked out a side window when you were riding in a car? If so, you noticed that the things you passed seemed to move. These things seemed to move because an image of them could not form on your retinas fast enough for you to see them standing still.

When you watch a movie, still things also seem to move. A movie is made up of hundreds of still pictures. These pictures are shown quickly on a screen. An image of each picture forms on your retinas. However, your

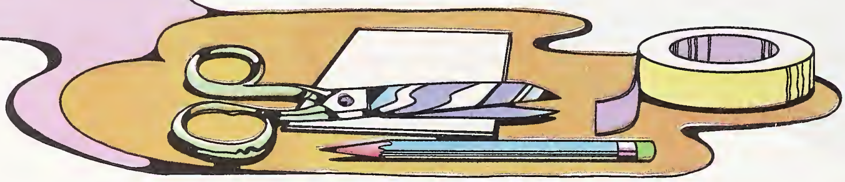
FINDING OUT

How can you make two pictures into one?

You will need: pencil, cardboard, scissors, tape

- Cut the cardboard into a square 8 cm by 8 cm in size.
- Draw an animal on one side of the cardboard. On the other side, draw several lines up and down as pictured.
- Tape the cardboard to the top of the pencil as pictured.
- Spin the cardboard.

What happened to the animal? Why?



Teaching helps for "Finding Out":
Processes used: observing, inferring.
Sample findings: The pupils will most likely observe that the animal seems to be behind the lines as if it were in a cage. From this, the pupils will probably infer that the pictures move quickly and their eyes hold the images of each picture for a moment so that the images are blended together.

When might things look this way to you? Why?

eyes hold each image for a moment after the picture is gone. This image blends with the image of the next picture so that it seems as if the things in the pictures are moving. Have you ever made still pictures seem like they were moving? If so, how?[1]

Seeing optical illusions. Many things that seem to play tricks on you, such as afterimages, can be explained. But some things that you see cannot be explained. Many of these things are called *optical illusions.* Optical illu-

[1] **Sample answers:** Yes. By drawing a sequence of pictures on a pad of paper and flipping the pages quickly.

Suggested research: After discussing "Seeing still things move" on pages 176 and 177, you may wish to have the pupils find out more about light and movies. Have the pupils look under the heading *motion pictures.*

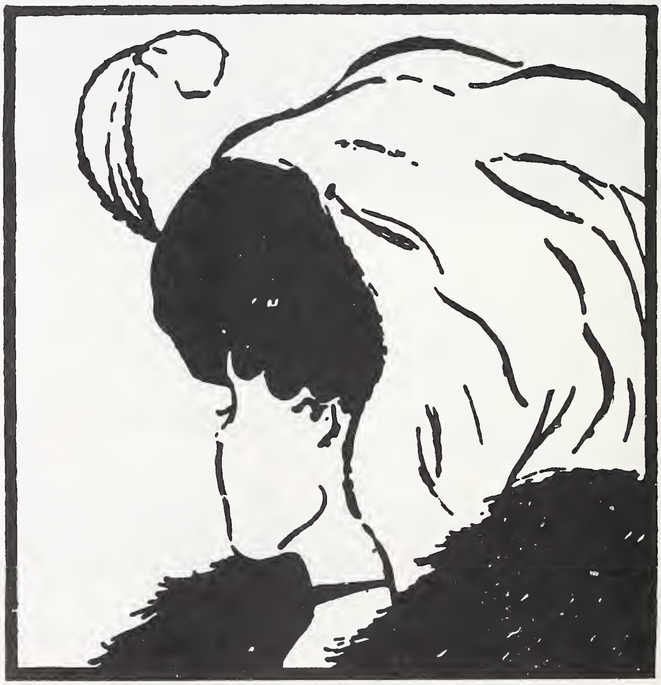
Suggested activity: After discussing "Seeing still things move," you may wish to have the pupils make their own moving pictures. Have the pupils draw a series of pictures on note cards. Each picture should be a little different. Have the pupils staple the cards together and flip through them quickly.

Sample answers for the caption: When I am moving fast. Because the image of these things can't form on my retinas fast enough for me to see these things clearly.

sions are things that may be seen in more than one way. The picture below is an optical illusion. It can be seen as an old woman or a young woman. Can you see both women? If so, which did you see first?

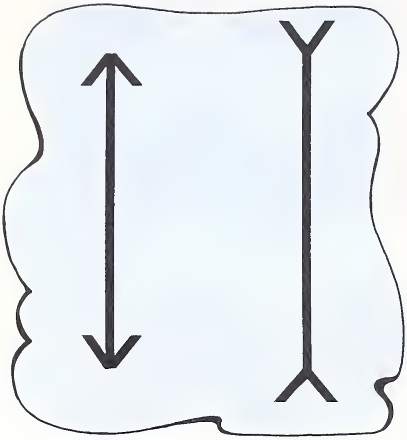
You may have found it hard to see both women in the picture. When you look at something that is an optical illusion, your brain chooses to see it one way. When another way of seeing that thing is suggested, your brain may find it hard to see it this way. It is not known why your brain chooses one way instead of another. Some people believe that your brain guesses about the things you look at according to what you have seen before. Why do you think your brain chooses to see something one way instead of another?[1]

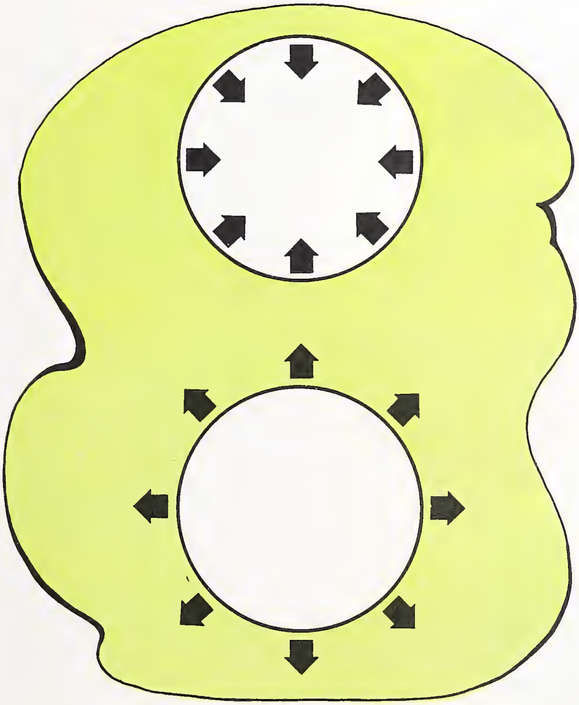
[1] **Sample answer:** Because my brain guesses about something according to which part of that thing my eyes look at first.



Teaching helps for the picture above: The pupils may not be able to see both women in this picture right away. You may wish to have the pupils stare at the picture for several minutes.

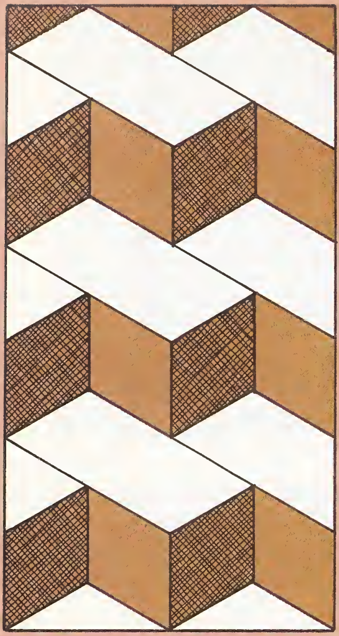
Look at the circles below. Which circle do you think is bigger? These circles are optical illusions. They look different in size, but they are really the same size. Some people think that the arrows cause you to think the circles are different in size. These people think the arrows make your eyes look away from or look toward a circle. But look at the lines to the right. These lines are the same length. Do you think the arrows on the lines and the arrows on the circles make your eyes do the same things? Why or why not?[1] Besides the arrows, what might cause these circles and lines to be optical illusions?[2]



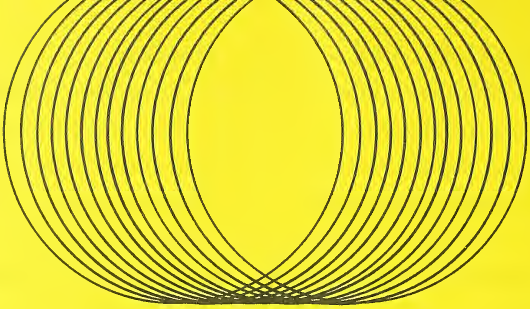


[1] **Sample answers:** No. Because the circle which seems bigger has arrows pointing away from it, and the line that seems longer has arrows pointing toward it.

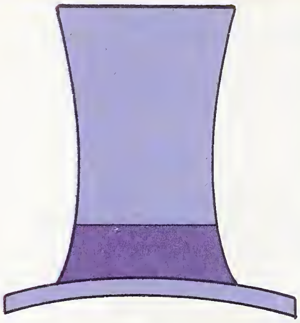
[2] **Sample answer:** Their shape, their size, the size of the lines.



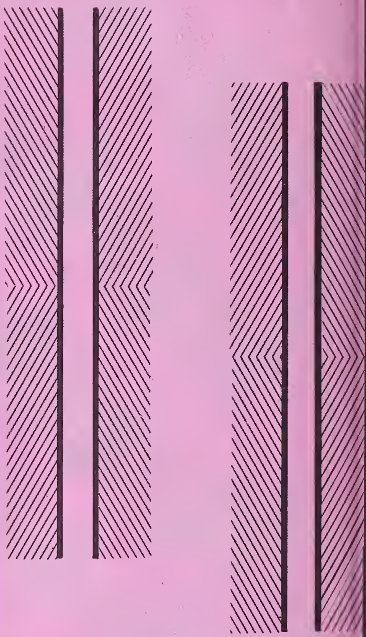
Is the white side of each block on the top or the bottom of the block?



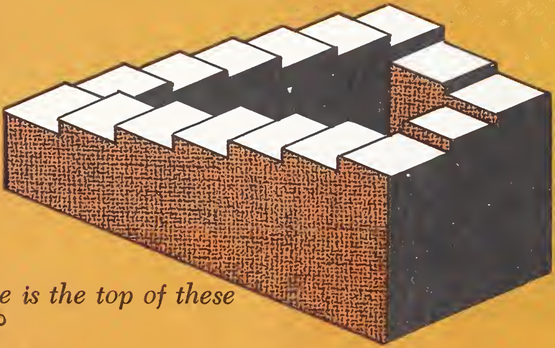
Is the opening of this tube on the right or the left?



Which part of the hat is longer, the top part or the brim?



Do you think the up-and-down lines in this picture are straight?



Where is the top of these stairs?

Teaching helps for the pictures above: To get the best results from the pictures above, tell the pupils to stare at each picture for a few minutes.

Sample answer for the top left caption: The white side may be seen either as the top or the bottom of the block.

Sample answer for the middle caption: The top part and the brim are the same length.

Sample answer for the bottom left caption: There is no top of these stairs.

Sample answer for the top right caption: The opening of the tube may be seen either on the right or the left.

Sample answer for the bottom right caption: All four of the lines are straight.

FINDING OUT

When is the full moon an optical illusion?

You will need: ruler, paper, pencil

- On a clear night when there is a full moon, look at the moon when it is low in the sky. Notice where you are standing.
- Hold a ruler at arm's length in front of you. Close one eye. Line the ruler up in front of the moon as shown.
- Look at the ruler. Write down the "size" of the moon.
- Later that night, stand in the same place. Look at the moon when it is high in the sky.

Did the moon look the same size as it did when you looked at it before? Why or why not?

- Use the ruler to "measure" the moon as you did earlier.
- Write down the "size" of the moon.

How is a full moon an optical illusion?

Problems in seeing

Though many people see very well, other people have problems in seeing. Some of these problems can be corrected. What are some problems in seeing that you know of? Can these problems be corrected? If so, how?[1]

[1] **Sample answers:** Blindness cannot be corrected. Nearsightedness can be corrected by using eyeglasses.

Teaching helps for "Finding Out":
Processes used: observing, measuring, comparing, collecting data, interpreting data.
Sample findings: After looking at the moon a second time, the pupils may find that it looked smaller when it was higher in the sky. They may say that the reason for this is that the moon is farther away from the earth later at night. After "measuring" the "size" of the moon a second time, the pupils will probably infer that the moon forms an optical illusion because it looks bigger when it is lower in the sky, but it is actually the same "size" and distance as it is when it is higher in the sky.

Nearsightedness and farsightedness. Perhaps the most common problems in seeing take place because people's eyes become the wrong shape. Sometimes people's eyes become longer from front to back than they should be. When these people look at faraway things, light from these things cannot reach their retinas to form a clear image. Because of this, these people cannot see faraway things clearly. Such people are said to be *nearsighted*. Why do you think people who cannot see faraway things are said to be nearsighted?[1]

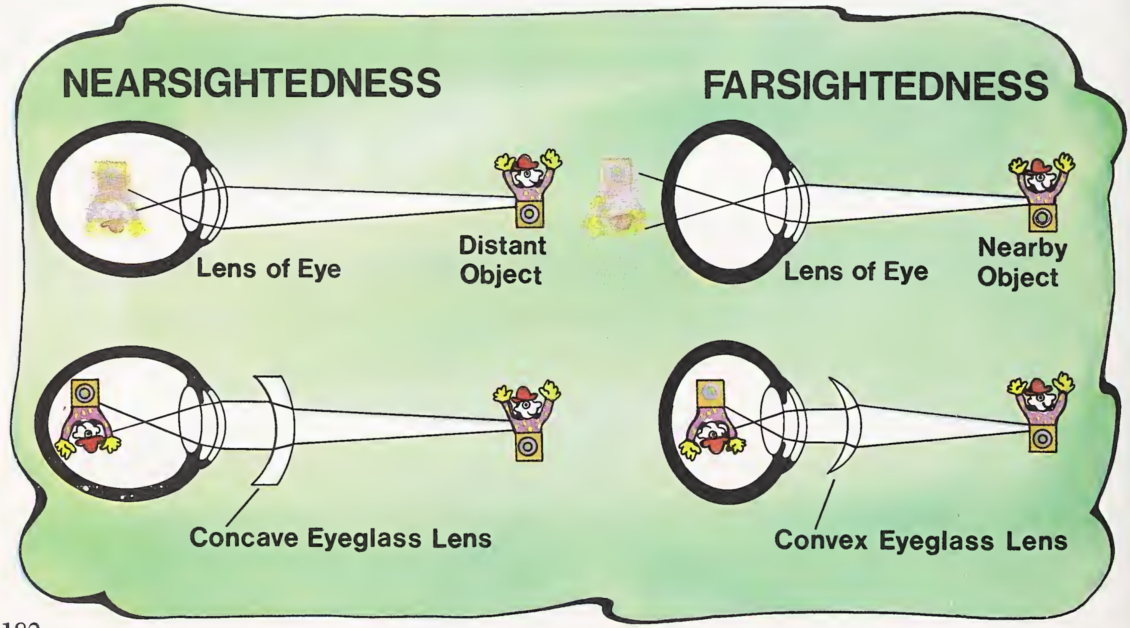
Sometimes people's eyes become shorter from front to back than they should be. When these people see nearby things, light from these things reaches their retinas before the light can form a clear image. These people cannot see nearby things clearly. Such people are said to be *farsighted*. Why do you think this is so?[2]

[1] **Sample answer:** Because they can see only nearby things clearly.

[2] **Sample answer:** Because they can see only faraway things clearly.

Exploring on Your Own

A problem in seeing that many people have is called *astigmatism*. People with this problem wear glasses to help correct it. See if you can find out what causes astigmatism.



Sample findings for "Exploring on Your Own": Astigmatism is caused by an abnormal curve of the cornea, which keeps light from focusing equally on the retina. This problem may result from a disease or an injury, or a person may be born with the problem.

Suggested research: After discussing the material on pages 182 and 183, you may wish to point out that a problem in seeing which cannot be corrected is colour blindness. Then you might want to have the pupils find out about this problem by looking in reference books under the heading *colour blindness*.

Nearsightedness and farsightedness are both problems in seeing that can be corrected. People with these problems should visit an eye doctor. Such a doctor can help these people get glasses that correct the problem.

Blindness. There is one problem in seeing that most often cannot be corrected. That problem is *blindness*. Some people are born blind. Some of these people's eyes or brain did not grow properly before birth. Some other people are blind because an injury or disease has damaged their eyes or brain. For instance, damage to the corneas or lenses can keep light from forming an image on the retinas. Damage to the retinas can keep messages from being sent to the brain. Damage to the brain can keep the brain from getting or understanding messages. What things might you do so that your eyes or brain do not become damaged? [1]

[1] **Sample answers:** Wear sunglasses in very bright light; wear a protective helmet when I play baseball or football.

For You to Think About

Suppose you wanted to describe yourself to someone who had never seen anything. What things would you say? Why?

Sample answers for "For You to Think About": Though people who are blind may not know what they look like, they probably know what their body feels like. So I would say things like "My hair is longer than yours," "My nose is bigger than yours," and "I am shorter than you."

Suggested activity: After discussing "Blindness," you may wish to involve the pupils in an activity which would help them understand more about this problem. Have the pupils cover their eyes and try to do things that they normally do. Have the pupils discuss their experiences and feelings. You might then have the pupils write to a school for the blind to find out about how blind people are able to read.

Taking care of your eyes

Though some problems in seeing cannot be prevented, others can be prevented. You can prevent some problems in seeing by taking care of your eyes. Which of the following ways to take care of your eyes do you follow?

- Visit an eye doctor for regular checkups and whenever you have problems with your eyes.
- Never rub your eyes. Whenever something gets in them, let tears wash it out of your eyes or run water in your eyes to wash it out.
- Read or watch television in good lighting.
- Wear sunglasses when light is very bright.
- Close your eyes to rest them after you read for a long time.

Suggested activity: After discussing "Taking care of your eyes," you may wish to involve the pupils in an activity which would help them become aware of ways they can help their eyes. Have the pupils make a list of things they do to take care of their eyes. Have the pupils compare their list with those of other pupils in their class.

Some interesting eyes

Just as you have eyes to see, many animals have eyes. But some animals can see farther than you can. Some can see better in the dark than you can. Some can even see things everywhere around them. What are some animals you know of that can see better than you can? In what way do they see better? [1]

The way animals see depends on what kind of eyes they have. For instance, owls have eyes with large pupils. Large pupils allow these birds to see well at night. Owls hunt for their food at night. Cats have eyes with oval pupils. These pupils allow cats to see well in the night or the day. Cats, such as lions and tigers, hunt for their food both in the night and the day.

The pictures on pages 186 and 187 show the eyes of different animals. How are the eyes of these animals different from your eyes? How might the eyes of these animals be helpful to them in seeing? Which animals have eyes in different parts of their head than you do? How might having eyes in these parts of the head be helpful in seeing? [2]

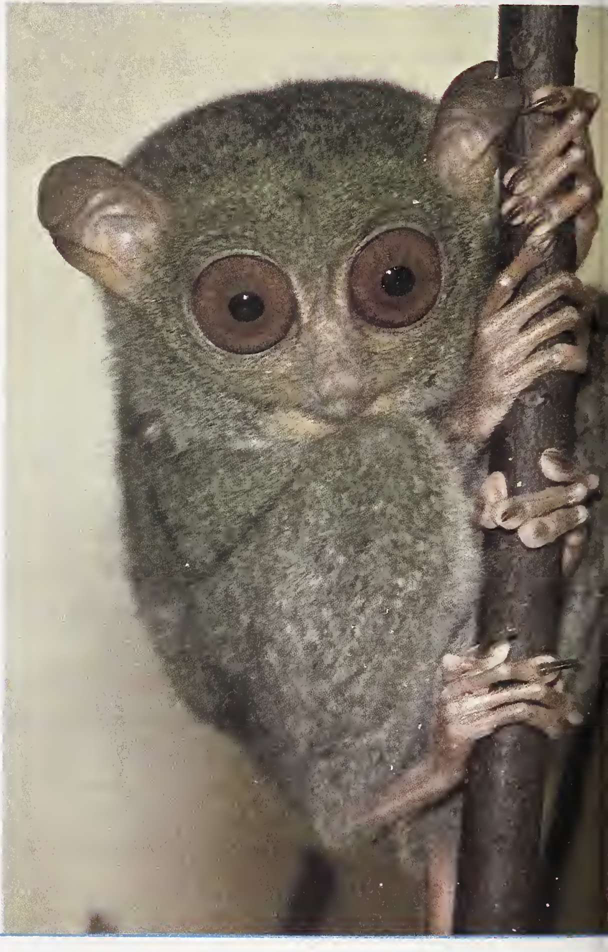
[1] **Sample answers:** Eagles can see something small very clearly from many feet in the air. Owls can see well at night.

Suggested research: After discussing "Some interesting eyes," you may wish to point out to the pupils that though some animals can see better than they can, other animals cannot see as well as they can. You might want to have the pupils find out about some of these animals. Have the pupils look in reference books under the headings of individual animals such as *ants*, *bats*, and *spiders*.

[2] **Sample answers for pictures on pages 186 and 187:** The irises of the gecko are different in colour and shape from mine. When they close, they make the pupils look like tiny diamonds. The tiny pupils keep out bright sunlight, but allow the gecko to watch for enemies. Unlike my eyes, the eyes of the fly are made up of many tiny eyes. These eyes cover most of the fly's head, which

Gecko

Fly



Tarsier

makes it possible for this animal to see almost everything around it. Unlike my eyes, the eyes of the tarsier are extremely large in proportion to its head and help this animal see at night. The irises of the tarsier are also different in colour from my irises. Unlike my eyes, the eyes of the crab and of the snail are on stalks. Having eyes on stalks is helpful to these animals because the animals can see all around them without turning their body. The eyes of the frog bulge from the top of its head and aid the frog in seeing things above it as it swims.

Crab

Frog

Snail

A Second Look

1. What are some reasons why seeing is important?
2. What are the parts of your eyes, and how do these parts help you see?
3. How is seeing with two eyes more helpful than seeing with one eye?
4. What are some ways you can take care of your eyes?

Sample answers for "A Second Look": 1. Seeing can help you find your way, learn about things, keep safe, and understand people. 2. My corneas bend light toward the inside of my eyes. My irises control the size of my pupils and, therefore, the amount of light that enters my eyes. My lenses bend light so I see things clearly. The cells of my retinas send messages about what I am looking at to my optic nerve, which carries the messages to my brain. 3. I see more of something and more things around me. 4. I can visit a doctor for regular checkups, watch television or read in good lighting, and never rub my eyes.

Workers Who Use Science

There are many people who must know much about light in order to do their job. Some of these people are *photographers.*

As you may know, photographers take pictures with a camera. When they take a picture, light enters the camera. The light forms an image on certain paper called film.

Photographers must know about light in order to take good pictures. Too much light entering a camera can make a picture look too light. Too little light entering a camera can make a picture look too dark. Photographers can change a camera so that it lets in the right amount of light. They can also use different kinds of film in different kinds of light.

Some photographers also make pictures from the film they use. These pictures must be made in a room where there is no light. Why? 1

To find out more about photographers, try to find answers to these questions:

What do aerial photographers and scientific photographers take pictures of? 2

How can a photographer tell how much light is needed to take a good picture? 3

Besides cameras, what other equipment do photographers need to do their job? 4

Along with using sources of your own, writing to this source may help you: Professional Photographers of Canada, Inc., Box 697, Adelaide Street Post Office, Toronto, Ontario.

Sample answers for "Workers Who Use Science":

[1] Because the film has been exposed to just enough light to make a good picture, and any more light on the film would ruin the picture.

[2] Aerial photographers take pictures of things such as buildings and land from airplanes for news publishers and other companies. Scientific photographers take pictures of things such as those that can be seen only under microscopes for science journals and science research.

[3] The best way is by using one of several instruments called light meters. Light meters measure the amount of light shining on something or the amount of light bouncing from something.

[4] Filters are added to a camera to lighten or darken parts of a picture. Flashbulbs and photoflood lamps are used to give more light. Special lenses are added to a camera to make a picture clear.

Reviewing the Main Ideas

Light travels in a straight line.
Light cannot pass through things that are opaque.
Light scatters when it passes through things that are translucent.
Light can travel straight through or bend when it passes through transparent things.
You are able to see because light bounces off things to your eyes.
When light bounces off smooth, shiny things, it may bounce an image.
White light is made up of many colours.
Coloured light may cause things to look a different colour than they look in white light.
Two eyes help you see more of something.
Two eyes help you see more things around you.
Some things that you see may seem to play tricks on you.
Many people have problems in seeing. Some of these problems can be corrected.
Many problems in seeing can be prevented by knowing how to take care of your eyes.

Reading About Science

Asimov, Isaac. *Light.* Scarborough, Ontario: McGraw-Hill Ryerson Limited, 1970.
Catherall, E.A. and Holt, P.N. *Working with Light.* Toronto, Ontario: George J. McLeod Limited, 1976.
Gardner, Robert and Webster, David. *Shadow Science.* Toronto, Ontario: Doubleday Canada Limited, 1976.

Reviewing the unit: You may wish to have the pupils study "Reviewing the Main Ideas" to help prepare for "Testing for Understanding" on page 190.

For further reading: You may wish to encourage the pupils to read the books listed under "Reading About Science" and other books and articles related to the topic of light. Such articles might be found in reference books under the headings *colour vision, paints, photography, television, colour blindness,* and *brain.*

Testing for Understanding

Ideas to Check

On your paper write *T* for each sentence below that is true. Write *F* for each sentence that is false.

T 1. Things look colourful because of the way light bounces off them.
F 2. Light bends when it travels through opaque things.
F 3. The colour of something looks the same in different kinds of white light.
T 4. Light travels in straight lines.
F 5. People who are farsighted can see nearby things clearly.
T 6. You should never rub your eyes when something gets in them.

Words to Use

Write on your paper the word that best fits in each blank below. Choose from these words: *cornea, pupil, retina, opaque, transparent, translucent, prisms, pigments.*

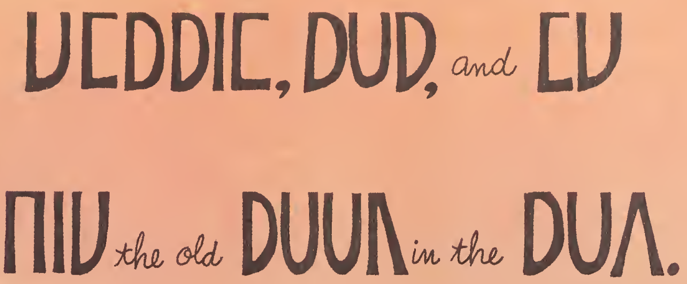
1. Light enters the eye through an opening called the ——. **pupil**
2. When light travels through —— things, it scatters. **translucent**
3. —— are pieces of glass that bend light into a spectrum. **prisms**
4. Light forms an image on part of the inside wall of the eye, called the ——. **retina**
5. When light travels through —— things, it passes straight through or bends. **transparent**

Suggestions for evaluation: You may wish to use the test questions provided under "Testing for Understanding" to evaluate the pupils' understanding of the main ideas and important words of this unit. Additional test questions for the unit "Light" are provided for you on page T19 of the Teacher's Manual. These test questions may be duplicated for classroom use. Answers to these additional test questions can be found on page T22 of the Teacher's Manual.

Having Fun with Science

Secret Message

You can read this secret message. Put one edge of a mirror so that it touches the top of the large secret words.



Now try making your own secret messages with secret words.

Things to Do

1. Take a survey about colour. Ask about twenty-five people some questions such as the following: What is your favourite colour, and why? How does the colour red make you feel? How does the colour blue make you feel? What does the colour yellow mean to you?

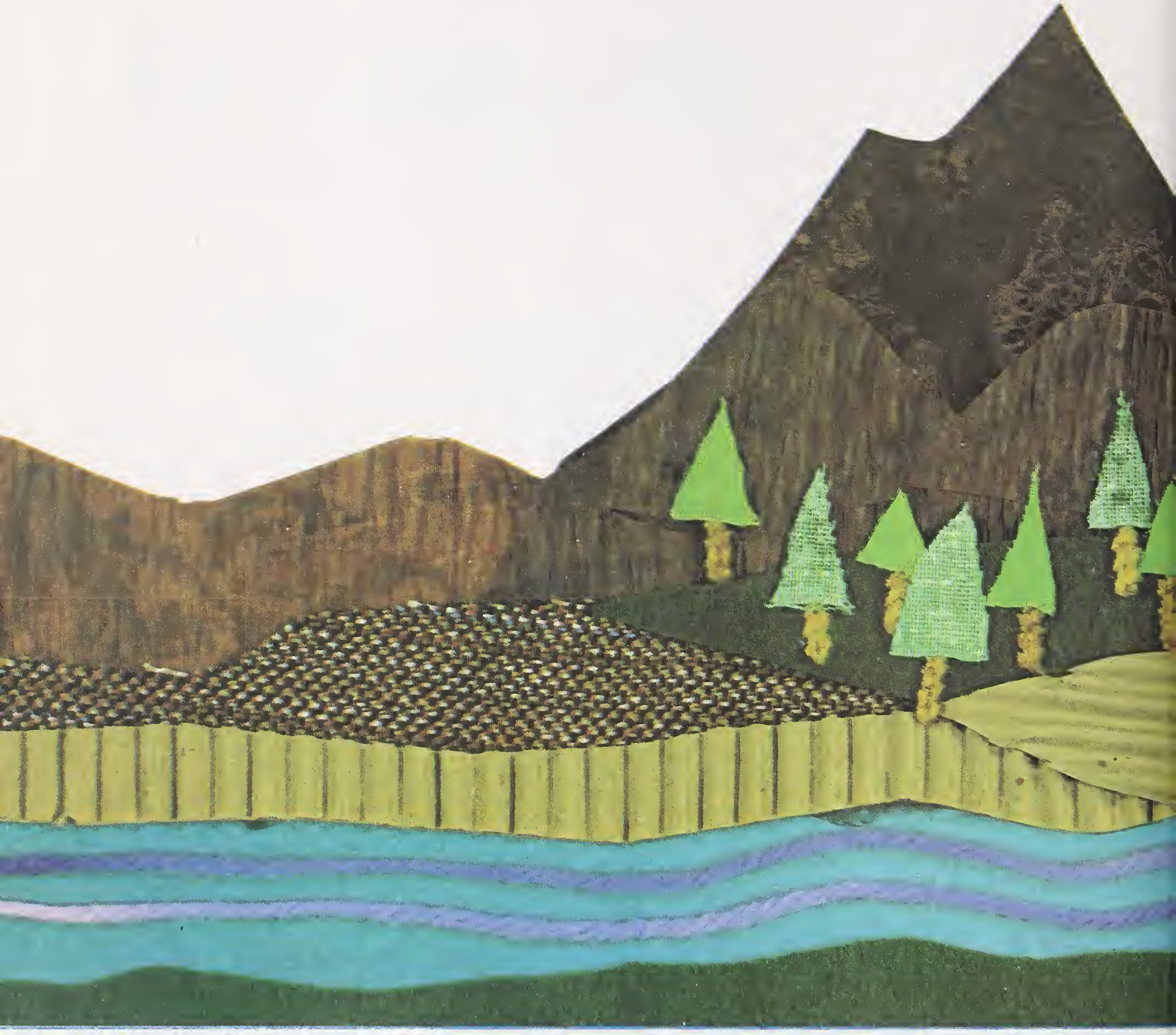
2. There is a spot on the retina of each eye where there are no special cells to send messages about an image to your brain. When light shines on this spot, you cannot see anything. This spot is called the *blind spot*. You can find your blind spot by drawing two dots on a piece of paper. Make the dots about 8 cm apart. Then, hold the paper about 30 cm in front of your eyes. Close your right eye. Stare at the dot on the right with your left eye. You should be able to see both dots. Slowly, move the paper toward your eyes. Stop when you can see only the right dot. At this point, light from the left dot is shining on your blind spot. What happens to the dots when you move the paper even closer to your eyes?

For further involvement: You may wish to use "Having Fun with Science" to involve the pupils in fun activities which reinforce some of the main concepts of the unit "Light." You may also wish to encourage the pupils to make up additional activities related to the topic of light.

Answer for "Secret Message": DEBBIE, BOB, and ED HID the old BOOK in the BOX.

5 The Changing Land

1 What causes the land to change?
2 What's so special about rocks?
3 What's so special about soil?
4 How can land be used wisely?



Preparing for the unit: For a list of instructional materials helpful in teaching this unit, see page T14 of the Teacher's Manual. You may also wish to check the list of materials needed for each "Finding Out" activity in this unit and have the pupils begin collecting these materials. These activities are found on pages 197, 199, 201, 210, 212, 225, and 229.

It probably took millions of years for this rock to be made from sand.
Really?
Yes. And it may take millions of years for it to be broken down into sand again!
Wow!
Hey! Why did you do that?
Well, it hardly seemed worth the wait!

What things in nature might cause rocks to be broken down?[1]

In what way do you think rocks are important to people?[2]

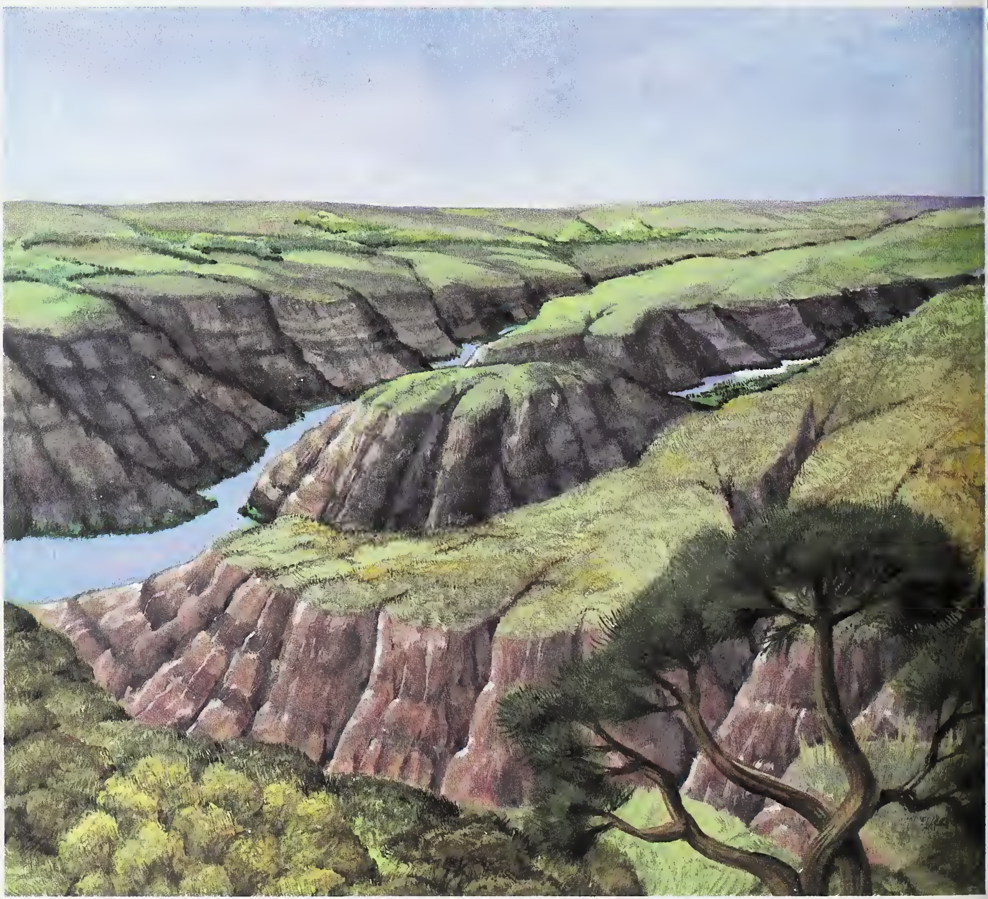
Introducing the unit: You may wish to have the pupils read the cartoon above. Then have the pupils read the questions below the cartoon and discuss their answers to the questions.
Sample answers for questions below the cartoon:

[1] Water and wind are some things in nature that might cause rocks to be broken down.
[2] I think rocks are important to people because people use rocks to make many things.

1 What causes the land to change?

Have you ever wondered what the earth looked like millions of years ago? The picture below shows a part of North America as it probably looked millions of years ago. The picture on the next page shows the same place as it looks today. In what ways has this place changed? 1

[1] **Sample answer:** It has changed into a deep and wide canyon. The plants are very different.



Main concepts of the chapter (pages 194–205):
There are forces on the surface of the earth which change the land.
There are forces within the earth which change the land.
Performance objectives: After studying the information provided in this chapter, the pupils should be able to
—list at least three forces on the surface of the earth which change the land and explain how each force changes the land;
—list two forces within the earth which change the land and explain how each force changes the land.
Important words: forces, dissolving, crust, mantle, core, molten, fault, earthquake.

Forces on the surface of the earth

There are many forces that change the rocks and soil which make up the land. Some of these forces are on the surface of the earth. What do you think some of these forces are?[1]

[1] **Sample answer:** Rivers, rain, wind.

Suggested research: After discussing the changes that have occurred in the Grand Canyon, shown in the drawing on page 194 and the photograph on page 195, the pupils might want to find out about changes that have occurred in various parts of Canada. You may wish to refer them to reference books such as *The Illustrated Natural History of Canada* to obtain this information.

Rushing water. Have you ever seen a river after a heavy rain? Or have you ever seen water rushing down the side of a street after a heavy rain? If so, you probably have noticed that the water often looks muddy. The water may also have leaves, twigs, and small stones in it. Rushing water often carries these kinds of things from one place to another. How might this cause the land to change?[1]

[1] **Sample answer:** It can cause deep gullies in some places and a buildup of land in other places.

Suggested research and discussion: After discussing "Rushing water," the pupils might want to find out about two land formations which show how land is changed by the force of rushing water. For the pupils to do this, have them look in reference books under the headings *Fraser River* and *Niagara Falls.* Then you might have the pupils discuss how the force of rushing water has changed the land around the Fraser River and Niagara Falls. (Sample finding: The Fraser River has cut a deep gorge through the mountains, and a wide river bed in the valley region. The Fraser River also carries a large amount of land to the mouth of the river, causing the formation of a delta. The Niagara River continues to cut away the rocks below and just behind the falls.)

Suppose you were to walk along the shore of an ocean or a large lake. You most likely would notice that the shore is sandy. You might also notice the force of the waves as they crash onto the shore.

Waves change the land in two ways. One way is by picking up rocks and grinding them against one another. In time, this grinding changes rocks into sand. How else do you think waves change the land along the shore?[1]

[1] **Sample answer:** Waves can carry some of the land away.

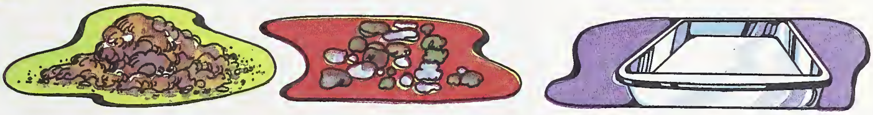
FINDING OUT

How can you show how waves change the land?

You will need: large pan, small rocks, soil

- Place some rocks in one end of the pan.
- Put some soil on top of the rocks and press the soil down.
- Put something such as a book under the end of the pan where the soil is.
- Pour some water into the other end of the pan.
- Use your hand to make some "waves." Splash them onto the soil and rocks.

In what way is the "land" being changed?
What do you think would happen if you were to make bigger waves? Try it.

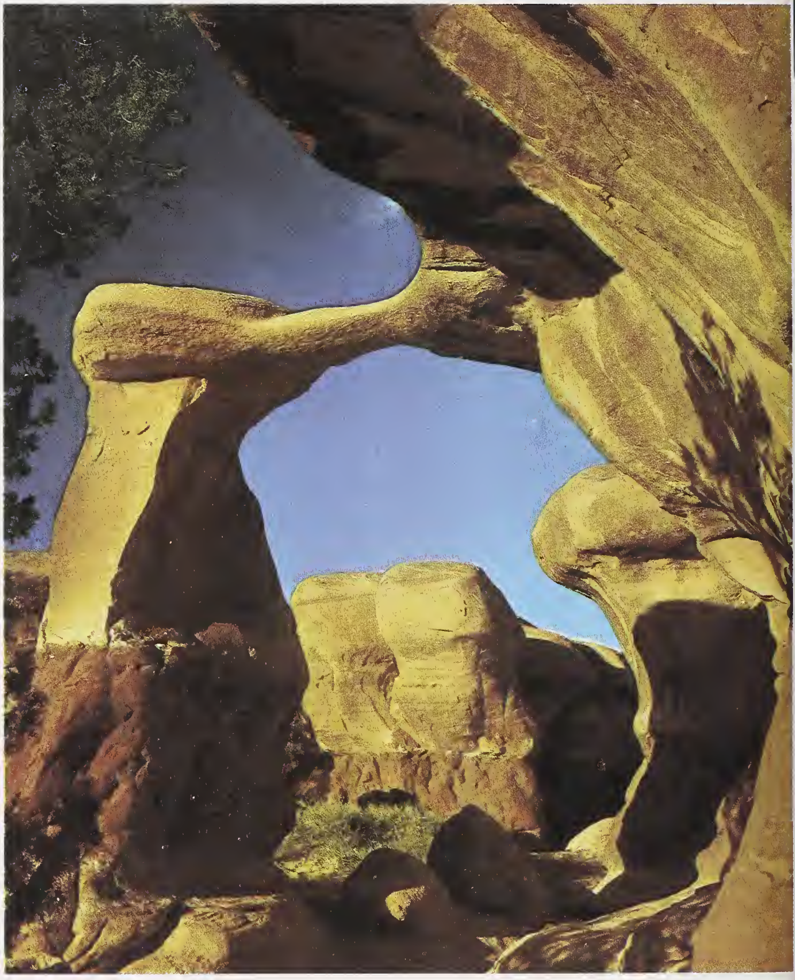


Teaching helps for "Finding Out":
Processes used: observing, communicating, predicting.
Sample findings: The pupils will most likely observe that the "waves" move some of the "land" from the high end of the pan to the low end of the pan. The pupils may predict that making the "waves" bigger will cause more "land" to move and to move more quickly than when the "waves" were smaller.

Rain. Another thing that changes the land is rain. Rain has a small amount of acid in it. This acid is very weak. Yet it can slowly break apart many rocks. The acid does this by *dissolving* [dihz-OLV-ihng] the rocks. How might this change the land? 1

[1] **Sample answer:** It can cause large rocks to be broken down into very small stones.

The smoothness of these rocks is one thing which shows they are being broken down by the acid in rain. What else do you think shows that the rocks are being broken down by the acid in rain?



Sample answer for the caption: The cracks in the rocks.

FINDING OUT

How does acid change some rocks?

You will need: cola, 2 pieces of limestone or 2 seashells, knife

The acid found in colas is the same as the acid found in rain.

- Keep one piece of limestone for later.
- Put one piece of limestone into a glass of cola.
- Listen to and watch what happens to the limestone.

What do you hear?
What do you see?

- Leave the limestone in the cola overnight.
- The next day, remove the limestone from the cola.
- Scrape the surface of the limestone with a knife.
- Then scrape the surface of the other piece of limestone.

How are the two pieces of limestone different from each other?

Plants. Have you ever seen plants growing between the cracks of a sidewalk? Or have you ever seen tree roots growing under the edge of a sidewalk? If you have, you know that in time the sidewalk may break into pieces. Why might this happen?[1]

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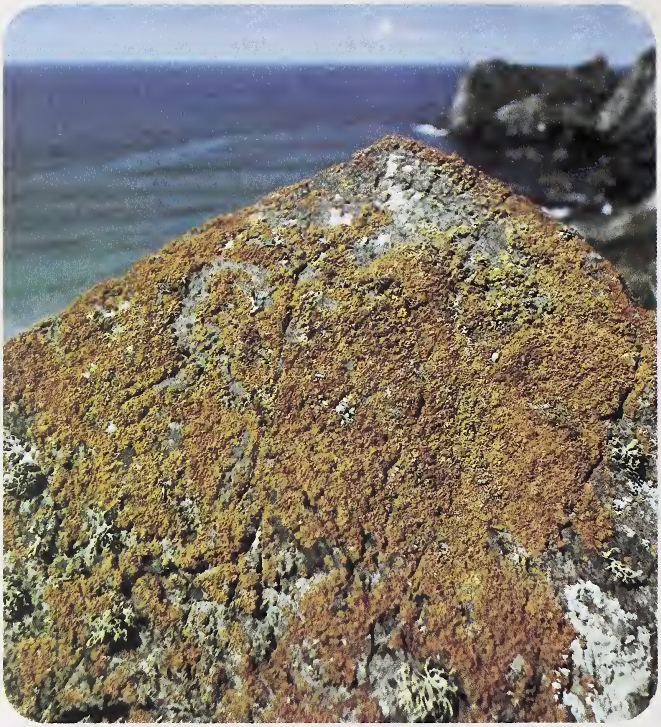
[1] **Sample answer:** As the plants grow, they take up more space, causing the sidewalk to break into pieces.

Teaching helps for "Finding Out":
Processes used: observing, comparing.
Sample findings: The pupils will most likely observe that the acid in the cola makes a fizzing sound as it changes the limestone and causes the limestone to foam. After the pupils have left one piece of limestone in the cola overnight, they will most likely observe a difference between this piece and the piece of limestone that was not placed in the cola. The pupils may say these pieces of limestone are different in that the surface of the limestone left in the cola is somewhat soft, whereas the surface of the limestone not placed in the cola is hard.

The tiny plants growing on this rock are called lichens. In what ways do you think the lichens are changing this rock?



There are also some tiny plants that often grow on rocks. These plants give off a weak acid. This acid softens the surface of rocks. As this happens, small cracks often form in the rocks. In time, larger plants may begin to grow in these cracks. As the roots of these larger plants begin to grow, they may make the cracks even wider. Do you think that in time such rocks could be broken into small pieces? Why or why not?[1]

Freezing water. Have you ever put a bottle of soda in a freezer to cool and then forgotten to take it out?

[1] **Sample answers:** Yes. Because the growing plants will keep taking up more space in the rocks until the rocks break apart from the pressure.

For You to Think About

There is another force which can change the land. This is the force of a *glacier*. A glacier is a large body of ice that slowly moves across the land. At one time, there were many more glaciers than there are now. How might the force of a glacier change the land?

Sample answer for the caption: By giving off a weak acid which softens the surface of the rock and by growing into small cracks in the rock, causing these cracks to become larger.

Sample answer for "For You to Think About": As a glacier moves across the land, the glacier carries soil and rocks to other places. Also, a glacier picks up large boulders which it carries across the land. And as the boulders are carried, they gouge great holes in the land.

Suggested research: After the pupils have discussed their answer for the "For You to Think About" above, they might discover what present land formations are the result of the force of a glacier. For the pupils to do this, have them look in reference books under the headings *glacier*, *ice age*, and *earth*. (Sample finding: Most of North America was covered by glaciers. The Great Lakes were formed by a glacier.)

If so, you may know that when you leave the bottle in too long, it will break. Why? [1]

Sometimes water gets into the cracks in rocks. As the water freezes, it expands, or gets larger. How might this change the rocks? [2]

Wind. Another force that changes the land is wind. In a desert, wind often picks up sand and blows it against large rocks. In time, this will cause small pieces of the rocks to break off.

Wind can change the land in another way. How else do you think wind can change the land? [3]

[1] **Sample answer:** When the soda freezes, it expands. And as the soda expands, it puts pressure on the bottle. When too much pressure builds up on the bottle, the bottle breaks.

[2] **Sample answer:** The water would make the rocks break apart.

[3] **Sample answer:** Wind carries land from one place to another.

FINDING OUT

How powerful is the force of freezing water?

You will need: empty milk carton, tape

- Fill the carton completely full of water.
- Tightly tape the carton shut.
- Put the carton in a freezer. Leave the carton there overnight.
- The next day, take the carton out of the freezer.

How is the carton changed from when you put it in the freezer?
Do you think you could use the force of freezing water to break rocks apart? Try finding out.

Teaching helps for "Finding Out":
Processes used: observing, experimenting.
Sample finding: The pupils will most likely observe that the carton is bulging or split open because of the expansion of the water as it freezes.

Forces within the earth

Have you ever seen pictures of a volcano erupting? Or pictures of what happens during an earthquake? If so, then you have seen some other ways in which the land is changed. But these changes are caused by forces within the earth. What do you think these forces are?[1]

[1] **Sample answer:** Pressure, heat.

In what ways do you think the land is being changed by this volcano?

Pressure and heat. In order to understand the forces within the earth, it is important to know what makes up the earth. Just below the rocks and soil on the surface of the earth is a layer of rock. It is called the *crust.* The crust is thought to be made up of large pieces of rock. These large pieces of rock are called

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Sample answer for the caption: Some of the land is being carried from one place to another by the lava. Some of the land is being built up.

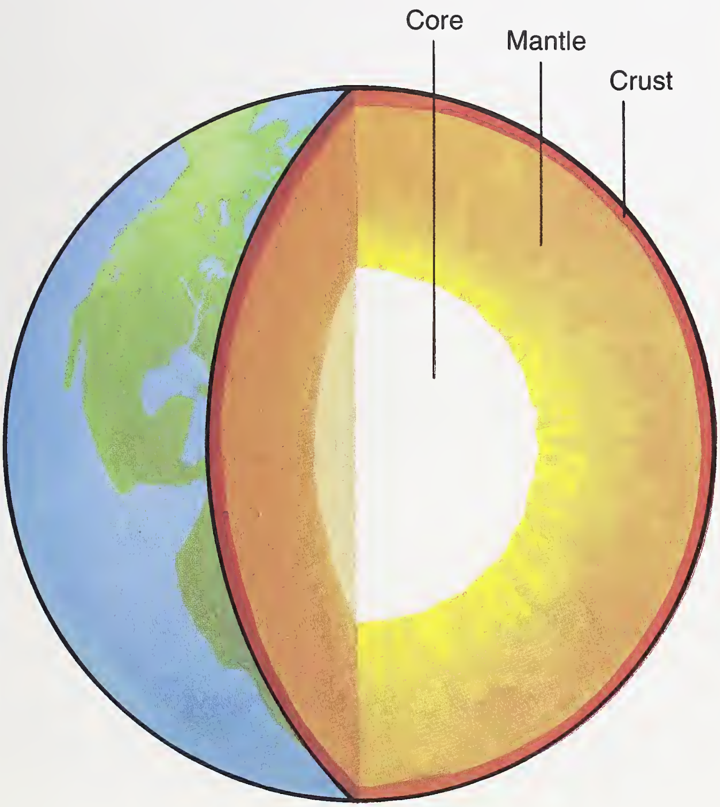
plates. These plates rest on another layer of rock called the *mantle*. The mantle in turn rests on the *core*, or center of the earth.

You most likely have weighed yourself many times. When you do, your weight puts pressure on the scale. Pressure is a kind of force. And the more you weigh, the greater the pressure is that you put on the scale.

For You to Think About

It is thought that the core of the earth is made up mostly of iron and nickel. But no one knows this for sure. Why do you think that no one knows this for sure?

INSIDE THE EARTH



Suggested research: After discussing the "For You to Think About" above, the pupils might find out about an attempt made to explore and study the earth's crust and mantle. For the pupils to do this, have them look in reference books under the heading *earth* or *Project Mohole*. Then have the pupils discuss their findings.

Sample answer for "For You to Think About": Because no one has ever seen the core of the earth.

It is thought that the core of the earth has a great amount of pressure on it because of the weight of the crust and the mantle. And it is thought that this pressure makes the core very hot. It is also thought that this heat causes part of the mantle and core to be *molten*, or liquid. Because these parts are thought to be molten, it is also thought that they move about very slowly.

Movement of the crust. As said before, the plates of the crust rest on the mantle. Because it is thought that part of the mantle is moving about, the plates are also thought to move about. Do you think that the movement of these plates can cause changes in the land? Why or why not?[1]

As the plates of the crust move about, their edges sometimes push against one another. In pushing against one another, a *fault*, or folding and cracking of the crust, may come about. If the folding and cracking take place very fast, this is called an *earthquake*. How might an earthquake change the land?[2]

Sometimes hot gases and molten rock from the mantle break through the crust. When this happens, a volcano is formed. How might the action of a volcano change the land?[3]

Still other times, the edge of one plate may push up the edge of another plate. When this happens, mountains are formed. Most of the mountains you may see now were formed millions of years ago. Yet some mountains are still being formed.

Most earthquakes and volcanoes seem to happen along the edges of the plates of the crust. How might knowing this be helpful to people?[4]

Exploring on Your Own

It is thought that all the continents of the world may have once been one large continent. This idea is known as the theory of *continental drift*. Try finding out more about this theory and about how it explains the position of these continents as they are today.

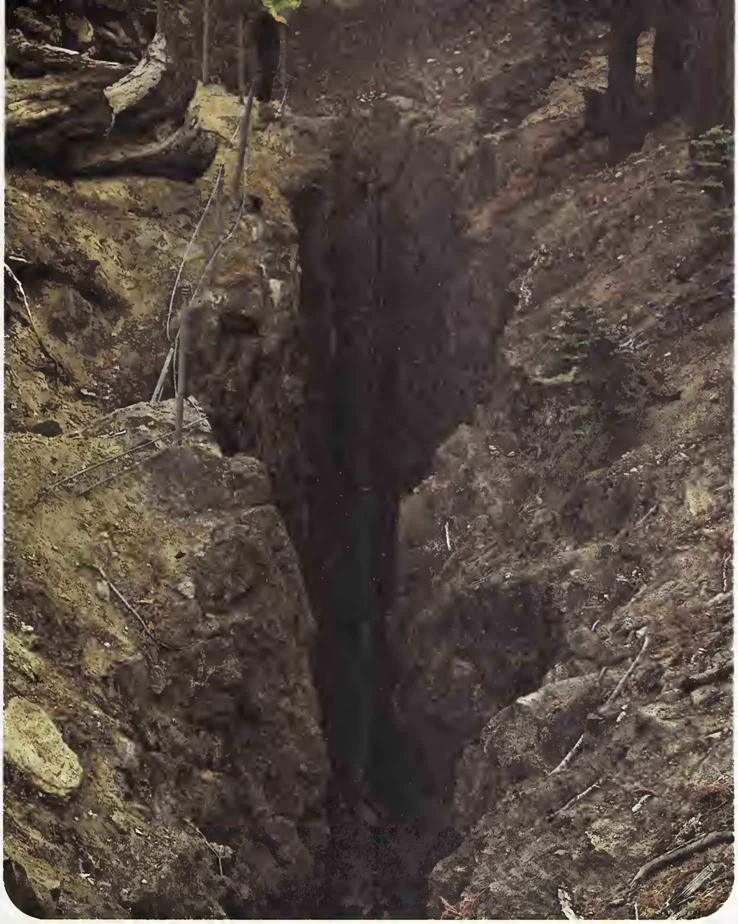
[1] **Sample answers:** Yes. Because as the plates move, they may not all move in the same direction or at the same speed. This could cause some of the plates to run into one another.

[2] **Sample answer:** An earthquake could make some land higher or lower than it was before. An earthquake could make some land flat and some hilly.

[3] **Sample answer:** It could kill many plants that grow on the land. It could form mountains and islands.

[4] **Sample answer:** It would help people know where not to build highways and homes or other buildings.

Sample finding for "Exploring on Your Own": Those who support the theory of continental drift state that the continents are in their present position because millions of years ago they split apart and began drifting on top of the mantle.



The movement of the earth's crust has caused this fault. How has this fault changed the land?

A Second Look

1. In what ways does rushing water change the land?
2. How do plants change the land?
3. How does wind change the land?
4. How does the movement of the earth's crust change the land?

Sample answers for "A Second Look": 1. Rushing water changes the land by grinding rocks against one another and by carrying soil and rocks from one place to another. 2. Plants change the land by growing into cracks in rocks, breaking the rocks apart. Some plants also change the land by giving off a weak acid which softens the surface of rocks. 3. Wind changes the land by picking up sand and blowing it against large rocks, causing small pieces of these rocks to break off. 4. The movement of the earth's crust changes the land by causing the formation of faults, volcanoes, and mountains.

Sample answer for the caption: The fault has caused a large opening in the crust. The fault has also caused the loss of plants that lived on that area of land.

2 What's so special about rocks?

You probably know that the crust of the earth is important because its movements bring about changes in the land. But the rock which makes up the crust is also important. Why might this be so? 1

[1] **Sample answer:** Because rock is used to make many things.

How are rocks used?

Suppose you were to make a list of all the things you know of that are made from rock. Might you list buildings? Statues? What other things might you list? 2

[2] **Sample answer:** Parts of some stairways and fireplaces.

Main concepts of the chapter (pages 206–217):
Rocks are made up of minerals.
Many things you use are made from minerals.
Rocks are different from one another because of how they are formed and because of the different minerals in them.

Performance objectives: After studying the information provided in this chapter, the pupils should be able to
- —list some things they use which are made from minerals;
- —state two ways in which rocks are different from one another.

Important words: minerals, quartz, halite, bauxite, sedimentary rock, sandstone, shale, limestone, fossils, magma, igneous rock, granite, lava, pumice, metamorphic rock, marble, gneiss.

What are rocks made of?

Have you ever made a cake? Or perhaps some cookies? If so, then you know that certain things must be mixed together in order to make a cake or cookies. Rocks are somewhat like this too. That is, rocks are made up of things called *minerals* [MIHN-(-uh)-ruhlz].

Have you ever looked at a rock and seen small, different-coloured spots in it? If so, then you have seen some minerals. What are some colours you have seen in rocks? [1]

[1] **Sample answer:** Red, brown, white, green.

Suggested research and activity: After the pupils have read "What are rocks made of?" they might find out how people identify minerals by looking for tests for minerals in reference books under the heading *minerals*. Then have the pupils collect some rocks and see if they can identify some of the minerals in these rocks by using these tests. (Sample finding: The tests the pupils will most likely discover will include tests for hardness, cleavage, streak, colour, and lustre. The materials needed and the steps required to perform these tests are listed in most reference books.)

A mineral hunt

Suppose you were to go on a mineral hunt. You might think that you would have to go outside. But you could look for minerals inside your home!

Although it may seem strange, there are many minerals or things made from minerals in your home. Do you have drinking glasses and windows in your home? If so, then you have things made from a mineral called *quartz* [KWAW(UH)RTS]. What other things in your home do you think are made from quartz?[1]

You most likely put salt on some of your food. This helps bring out the flavour of some foods. Salt is also a mineral. It is called *halite* [HAL-YT]. How else do you think salt is used?[2]

You may also have some things in your home which are made from aluminum. Pots and pans are sometimes made from aluminum. Aluminum comes from a mineral called *bauxite* [BAWK-SYT]. What other things in your home are made from aluminum?[3]

There are many other things that are made from minerals. Below is a list of some of these things. Which of these things are important to you? Why?

pencil lead
scouring powder
chalk
talcum powder
crayons
coins
mirrors
tin cans
thermometers
plaster
cement
sandpaper
diamonds and other gems
face powder
fertilizers
glass dishes
batteries
paint

Exploring on Your Own

There are many other minerals besides quartz, halite, and bauxite which are used to make things. Some of these minerals are *hematite*, *graphite*, *galena*, *cassiterite*, and *chromite*. See if you can find out what things are made from each of these minerals.

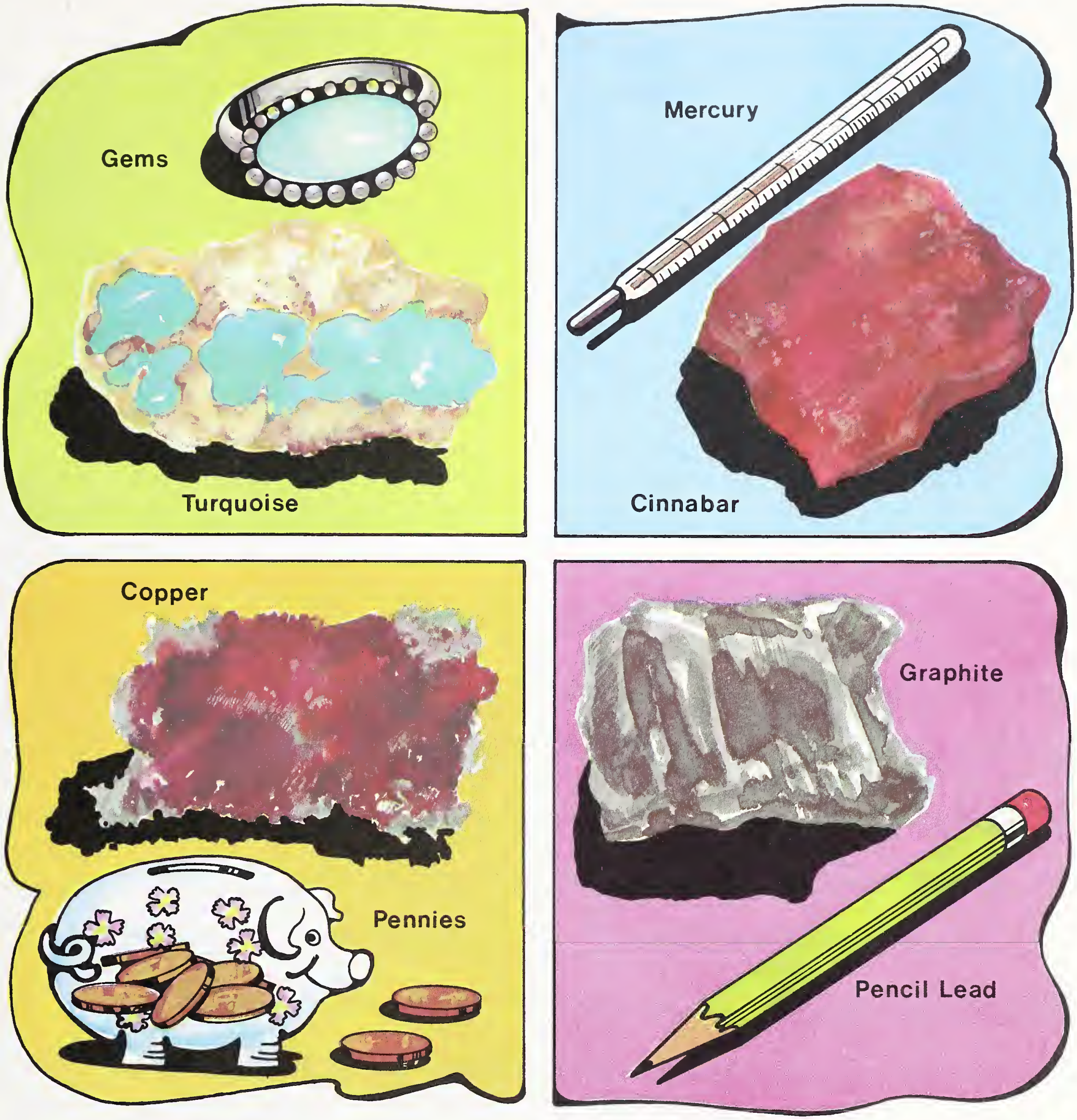
[1] **Sample answer:** Glass dishes, the glass part of light bulbs.

[2] **Sample answer:** To melt ice and to soften water.

[3] **Sample answer:** Parts of some furniture and appliances.

Sample findings for "Exploring on Your Own": Steel is made from hematite. Pencil lead is made from graphite. Lead is made from galena. Tin is made from cassiterite. Chrome is made from chromite.

SOME THINGS MADE FROM MINERALS



Suggested activity: After the pupils have discussed "A mineral hunt," they might go on a mineral hunt within the school. Have the pupils see how many things they can find within the school that are made from minerals.

FINDING OUT

How can you make "talcum powder"?

You will need: block of talc (from a rock shop or a rock collector), knife, 2 blocks of wood, talcum powder (from a drugstore)

- Shave some talc off the block of talc with a knife.
- Put this talc between the blocks of wood and grind it into a powder.
- Compare your "talcum powder" with the talcum powder from a store.

In what ways are they alike? Different?
What might you do to make your "talcum powder" more like the talcum powder from a store?

How are rocks formed?

You probably have noticed that some rocks look shiny and other rocks look dull. You may have also noticed that some rocks have many colours in them and other rocks have only a few colours. Rocks are different in these ways because of the different minerals in them. But rocks are also different from one another because of how they are formed. In what ways do you think rocks are formed?[1]

Layer by layer. You may remember that a river often carries soil and other things from one place to another. But as a river flows into an ocean, the water slows

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[1] **Sample answer:** By layers of soil pressing on other layers of soil. By heat within the earth.

Teaching helps for "Finding Out":
Processes used: observing, comparing, predicting.
Sample findings: The pupils will most likely observe that the two kinds of talcum powder are about the same colour. The pupils may also observe that the talcum powder they ground has a little rougher texture than the talcum powder they bought from a store. In addition, they may observe that the talcum powder they bought has a scent, whereas the talcum powder they ground does not. The pupils may predict that they can make their talcum powder more like that which they bought by grinding their talcum powder more and by scenting it.

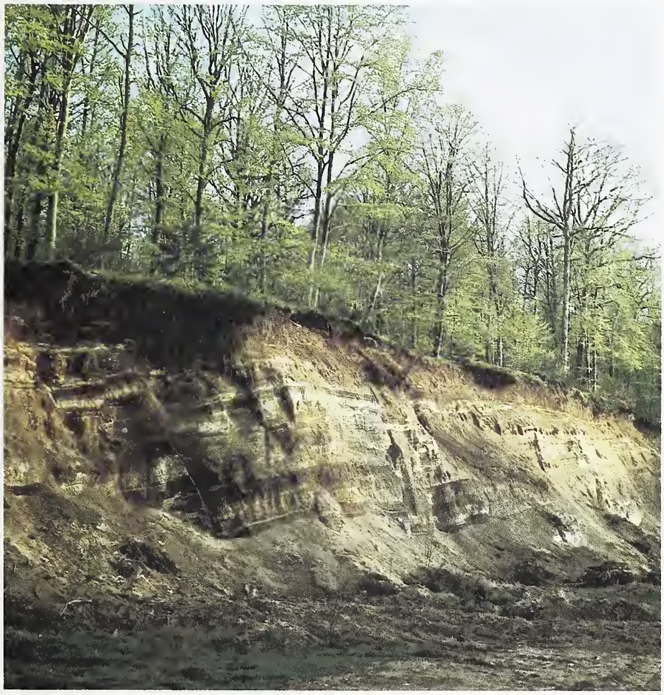
down. This causes the soil and other things to settle to the ocean floor. Ocean currents may then carry some of this soil farther out into the ocean. This soil also settles to the ocean floor.

As these layers of soil build up on the ocean floor, pressure is put on the bottom layers. This pressure is caused by the weight of the water and the weight of the top layers of soil. In time, this pressure can change the bottom layers of soil into rock. When this happens, a kind of rock called *sedimentary* [SEHD-uh-MEHNT-uh-ree] rock is formed.

The picture on this page shows sedimentary rock. Why do you think the rock looks layered? [1]

For You to Think About

Although sedimentary rock is formed under water, much of the land that people live on is sedimentary rock. How can this be so?



[1] **Sample answer:** Because it was formed in layers.

Sample answer for "For You to Think About": Because this land was once under water, but the movements of the crust forced this land above the water level, making it dry land.

There are many kinds of sedimentary rock. For example, there are *sandstone, shale,* and *limestone.* These kinds of rock are all formed layer by layer. But they are made up of different kinds of things. That is, sandstone is made up mostly of sand. Shale is made up mostly of clay. And limestone is made up mostly of bones and shells of dead animals.

FINDING OUT

How can you make "sandstone"?

You will need: paper cup, salt, spoon, sand, piece of sandstone

- Fill a paper cup half full of sand.
- Pour some salt into half a glass of water and stir.
- Keep adding salt until it no longer dissolves.
- Pour the salt water into the paper cup. Mix the sand and salt water together. Let the contents of the paper cup settle for about 10 minutes.
- After about 10 minutes, carefully pour off most of the water in the cup. Cut off the top of the cup and let the contents dry for 3 or 4 days.
- After 3 or 4 days, cut open the paper cup and carefully remove the dried "sandstone." Put the "sandstone" on a piece of paper and let it dry for another day.
- Compare your "sandstone" with the piece of real sandstone.

In what ways is your "sandstone" like the real piece of sandstone? In what ways is it different?
Would putting pressure on your piece of "sandstone" while it dried make a difference? Why or why not?

Teaching helps for "Finding Out":
Processes used: observing, comparing, inferring.
Sample findings: The pupils may observe that their sandstone and the real sandstone are about the same colour and texture. The pupils may also observe that their sandstone has a hard crust and loose sand within this crust, whereas the real sandstone is hard throughout. Also, their sandstone breaks apart more easily than the real sandstone does. The pupils may state that putting pressure on the sandstone as it dries will make the piece of sandstone harder. They may infer that this will happen because real sandstone has pressure on it when it is made and real sandstone is harder than the sandstone the pupils made.
Additional information: Have the pupils make two pieces of sandstone so that if one of the pieces is not dry enough and crumbles when removed from the cup, they will have another piece they can use in a day or two.

Sedimentary rocks are important because they are used to make many things. Limestone is especially important in the making of concrete. But sedimentary rocks are important for another reason. Have you ever seen a dinosaur bone? Or perhaps the print of a leaf in a stone? These things are called *fossils* [FOS-uhlz]. Almost all fossils are found in sedimentary rocks. For this reason, sedimentary rocks are important to people who study fossils. What things might people learn from studying fossils?[1]

[1] **Sample answer:** What the land was like many years ago and what plants and animals lived on the land many years ago.

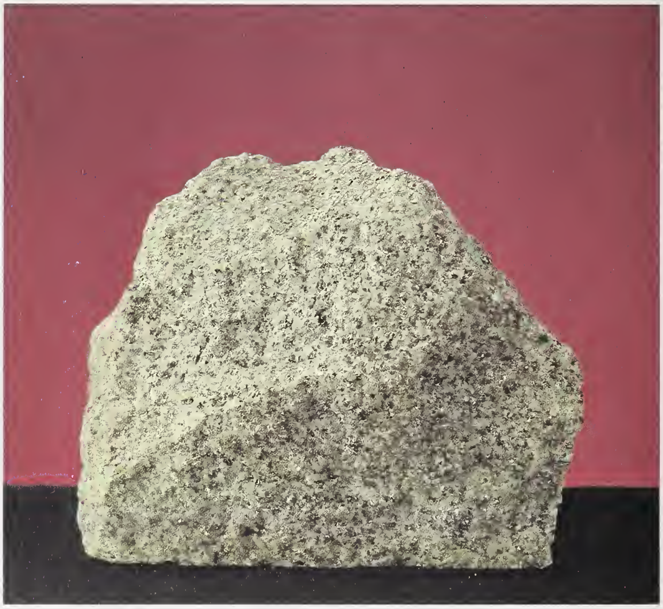
Why do you think fossils, such as this leaf print in shale, are formed mostly in sedimentary rock?

Sample answer for the caption: Because when plants and animals die, they become buried in soil. And this soil, in time, is changed into sedimentary rock.

Cooling off. There is another way in which rocks are formed. Within the earth is molten rock, called *magma* [MAG-muh]. Magma moves about slowly. Sometimes magma flows into cracks in the crust. As the magma does this, it often melts the rocks around it and forms pockets in the crust. In time, the magma cools. It then becomes a kind of rock called *igneous* [IHG-nee-uhs] rock.

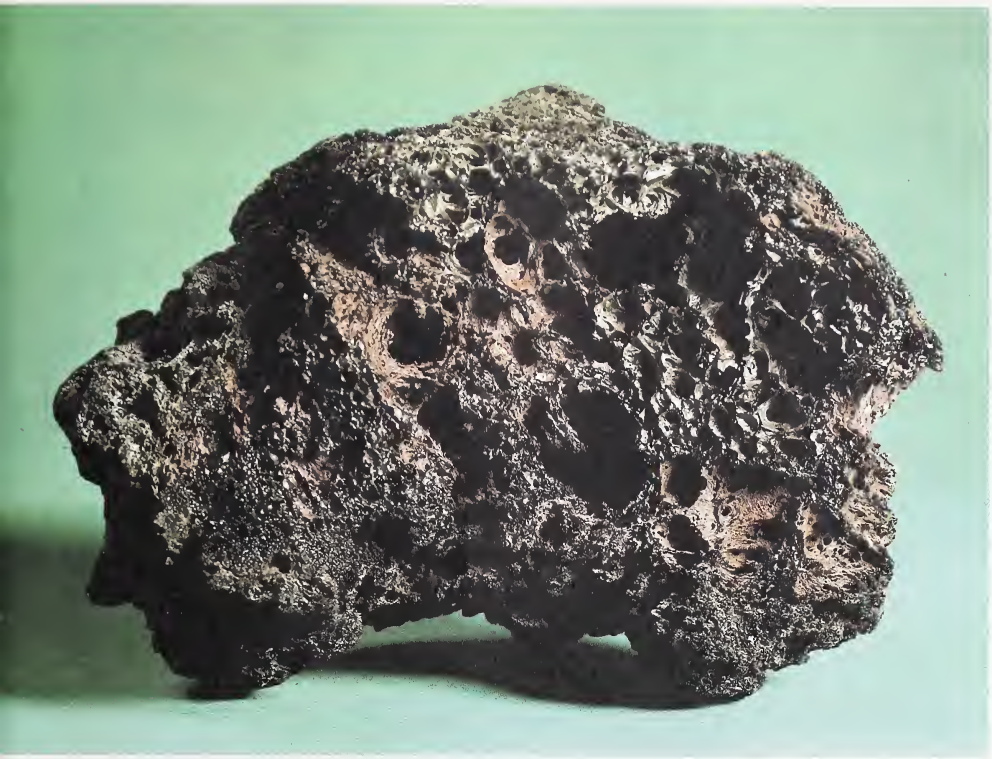
One kind of igneous rock is called *granite* [GRAN-uht]. Granite is very hard rock. Because of this, people use granite to make things they want to last for many years. What kinds of things might these be?[1]

The rock shown below is granite. Have you ever seen things made from this kind of rock? If so, what were some of these things?



[1] **Sample answer:** Parts of buildings, statues.

Sample answers for the caption: Yes. I have seen stairs and pillars made from granite.

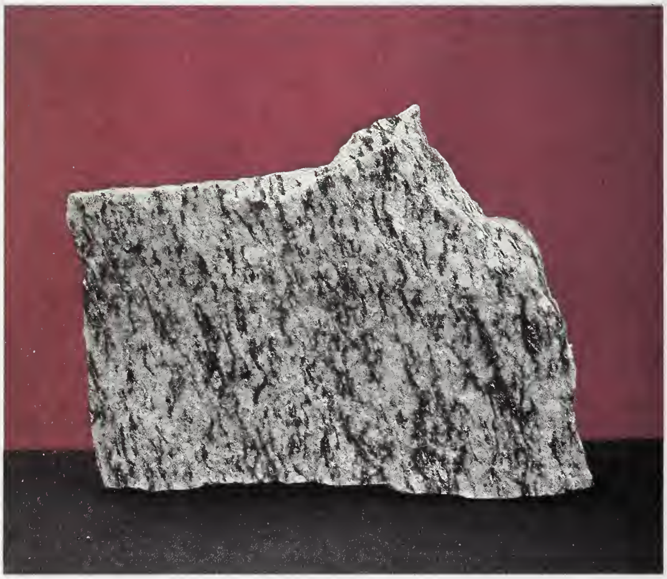


The rock shown above is pumice. Pumice is often easy to identify because of its light weight. Why do you think pumice has a light weight?

Sometimes magma does not stay within the crust. Instead, it breaks through the crust, forming a volcano. When magma cools on the surface of the earth, it becomes a kind of igneous rock called *lava.* Sometimes lava will have hot gases in it. When this lava cools, it has many holes in it. This kind of lava is called *pumice* [PUHM-uhs]. Pumice is often ground into a powder and used for polishing things.

Sample answer for the caption: Because of the many holes in it caused by hot gases.

Deeper and deeper. There is still another way in which rocks are formed. You may remember that the edges of the plates of the crust often press against one another. This often forces sedimentary and igneous rocks deep into the crust. When this happens, great heat and pressure within the earth change these kinds of rocks into another kind of rock. It is called *metamorphic* [MEHT-uh-MAWR-fihk] rock.



How is this metamorphic rock, known as gneiss, like the piece of granite shown on page 214? How do these rocks differ?

One kind of metamorphic rock is *marble*. It is formed from limestone, a sedimentary rock. Another kind of metamorphic rock is *gneiss* [NYS]. It is formed from granite, an igneous rock.

How do you think metamorphic rocks get to the surface of the earth?[1]

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[1] **Sample answer:** They are forced to the surface by the pressure within the earth.

Sample answers for the caption: The gneiss is like the granite in that they are both speckled with the same colour. These rocks are different from each other in that the gneiss is shiny and the granite is not.

The statue and the fireplace shown here are made out of marble. What other things do you know of that are made out of marble?

A Second Look

1. How are rocks used?
2. Why are minerals important?
3. How are rocks formed?

Sample answers for "A Second Look": 1. Rocks are used to build buildings and to make statues. 2. Minerals are important because they make up rocks and because many of the things people use every day are made from minerals. 3. Rocks are formed by pressure and by heat.
Sample answer for the caption: Some stairways. Other parts of buildings.

3 What's so special about soil?

Sweep the dirt off the sidewalk! Clean the mud off your shoes! You probably have heard these words many times. Most of the time, dirt and mud seem to be more of a bother than a help. But "dirt" and "mud" are just other words people use for soil. And soil is important to you. In what ways might soil be important to you?[1]

[1] **Sample answer:** It is used to grow the food I eat. It is used to grow things which then are used to make some of my clothing.

Main concepts of the chapter (pages 218–230):

Most of the food people eat and the clothing people wear come from plants grown in soil or from animals that are raised on plants grown in soil.

Rocks, minerals, plants, animals, air, and water are important to the makeup of soil.

Soil differs in colour, in rock size, and in chemical makeup.

Performance objectives: After studying the information provided in this chapter, the pupils should be able to

—state two reasons why soil is important to people;

—list at least four things that are important to the makeup of soil;

—list three ways in which soil differs.

Important words: nitrogen, decays, wastes, fertilize, humus, acids, bases, neutral.

The cotton being harvested here is used to make clothing. What clothing do you have that is made from cotton?

The importance of soil

Do you eat vegetables? Fruit? Meat? All the food you eat comes from plants or animals. Most of these plants are grown in soil. And most animals are raised on plants that are grown in soil.

Do you have clothing made from cotton? Leather? Wool? Cotton comes from plants. Leather and wool come from animals. What are some other things you use that are made from plants? From animals?[1]

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[1] **Sample answers:** Paper and the wood part of pencils and furniture are made from trees. Some pillows are made from the feathers of certain animals. Silk is made by silkworms. Glue is made from the parts of some animals.

The makeup of soil

You may remember that there are many forces which change the land. Some of these forces, such as heat, build up the land by forming mountains and new rock. Some of these forces, such as rushing water, break down the land by changing large rocks into smaller rocks. The forces which break down the land are also helpful in making soil. How do you think these forces are helpful in making soil?[1]

Rocks and minerals. Have you ever looked closely at some soil? If so, then you probably have seen small pieces of rocks and minerals in it. These smaller pieces of rocks and minerals, of course, come from larger rocks that have been broken down. But these small pieces of rocks and minerals are now an important part of soil. Why do you think rocks and minerals are an important part of soil?[2]

[1] **Sample answer:** They are helpful because a large part of soil is made up of very small pieces of rock.

[2] **Sample answer:** Because the rocks provide small spaces in the soil so air and water can get in. The minerals in soil help plants grow.

Trees, weeds, and other plants. Plants are also important to the makeup of soil. In what ways do you think this is so?[1]

You probably know that most plants have roots. As these roots grow, they break up the soil. This helps air and water get into the soil. Why might air and water be important to the makeup of soil?[2]

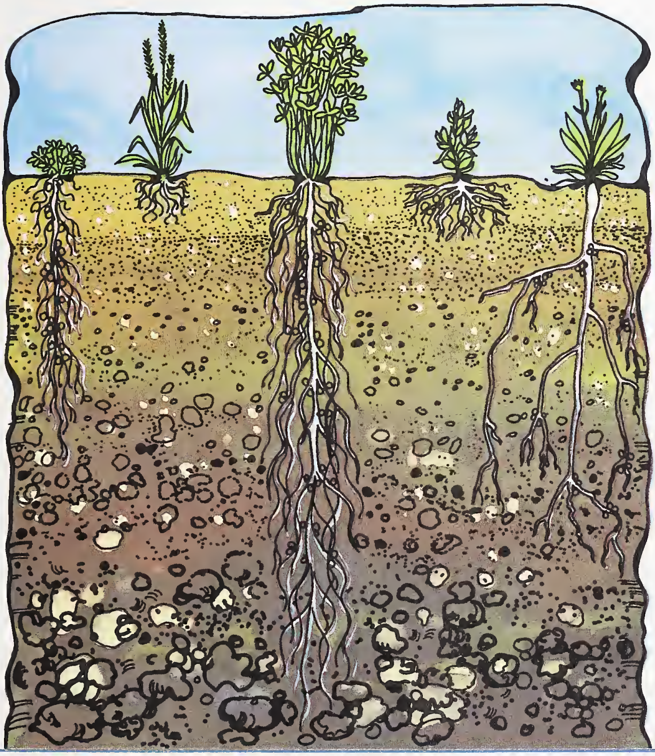
There is another way some plants are important to the makeup of soil. For example, plants such as peas and clover help put *nitrogen* [NY-truh-juhn] into the soil. Nitrogen is a gas found in air. All plants need nitrogen to live, just as they need certain minerals. But most plants cannot take nitrogen from air. Because of this, the plants that can take nitrogen from the air and put it into the soil are important to the makeup of soil.

[1] **Sample answer:** Plants help break up the soil so air and water can get in. Plants also help keep soil from being blown away by wind.

[2] **Sample answer:** Because they are needed by plants to grow.

Exploring on Your Own

Plants which help put nitrogen back into the soil are called *legumes*. See if you can find out how these kinds of plants help put nitrogen back into the soil.



Sample finding for "Exploring on Your Own": Certain bacteria called nitrogen-fixing bacteria grow in nodules on the roots of legumes. These nitrogen-fixing bacteria are able to take nitrogen from the air. These bacteria then change the nitrogen in such a way that plants can make use of it.

Teaching help for the picture above: After the pupils have discussed the "Exploring on Your Own" above, you may wish to use this picture to point out the nodules on the roots of these plants. It is within these nodules that the nitrogen-fixing bacteria grow.

There is still another way in which plants are important to the makeup of soil. You most likely have seen parts of dead plants in soil. When a plant dies, it *decays*, or breaks down. In time, the minerals in a decayed plant become part of the soil. How might this be important to the makeup of soil?[1]

Worms, bugs, and other animals. Have you ever seen an earthworm? If so, then you have seen one kind of animal that is important to the makeup of soil. In what ways do you think earthworms are important to the makeup of soil?[2]

Suppose you could watch an earthworm while it is in some soil. You would see that an earthworm digs tunnels in the soil. This digging helps loosen the soil so that air and water can get into the soil. Do you think it is important that air and water can get into the soil? Why or why not?[3]

There are many other animals that dig tunnels in soil. What animals do you know of that loosen soil in this way?[4]

[1] **Sample answer:** These minerals can then be used by other plants growing in the soil.

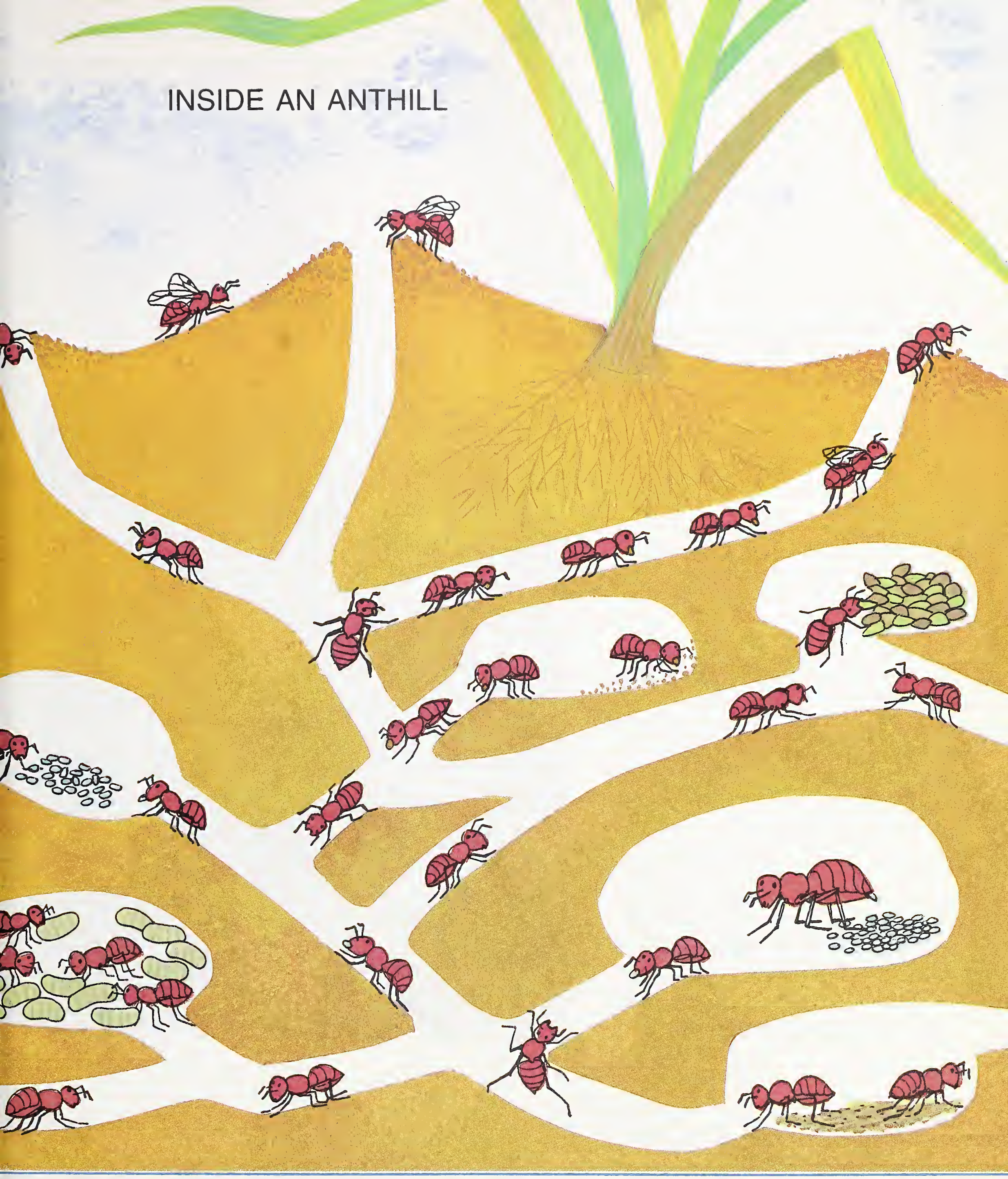
[2] **Sample answer:** The earthworms dig tunnels in the soil, which lets air and water in. When the earthworms die, they decay and become a part of the soil.

[3] **Sample answers:** Yes. Because plants need air and water to live.

[4] **Sample answer:** Ants, moles, gophers, snakes.

Suggested discussion: After the pupils have discussed the first paragraph on this page, you may wish to point out the following: After farmers harvest their crops, they often plow their fields. This mixes the weeds and the unused parts of the plants from which the crops came into the soil. Then you might ask the pupils this question: Why do you think a farmer might do this? (Sample answer: So as the weeds and the plant parts decay, some minerals are returned to the soil.)

INSIDE AN ANTHILL



Suggested discussion: Have the pupils look at the picture above. Then ask the pupils these questions: Do you think that ants are important to the makeup of soil? If so, why are they important to the makeup of soil? (Sample answers: Yes. Because their digging loosens the soil, allowing air and water to get into the soil.)

There is another way in which animals are important to the makeup of soil. You know that all animals eat food. Animals also give off *wastes,* or parts of food their body cannot use. These wastes become a part of soil and help *fertilize* [FURT-uhl-YZ] the soil. That is, these wastes make the soil better for plants to grow in.

At some time, you may have seen parts of dead animals in soil. When animals die, they also decay and become part of soil. How might this be important to the makeup of soil? [1]

[1] **Sample answer:** The decaying parts of animals help fertilize the soil.

This farmer is spreading wastes from cows on the soil to help fertilize the soil. Why do you think these wastes help fertilize the soil?

Sample answer for the caption: These wastes contain minerals that plants need to grow.

FINDING OUT

What are some things you can find in soil?

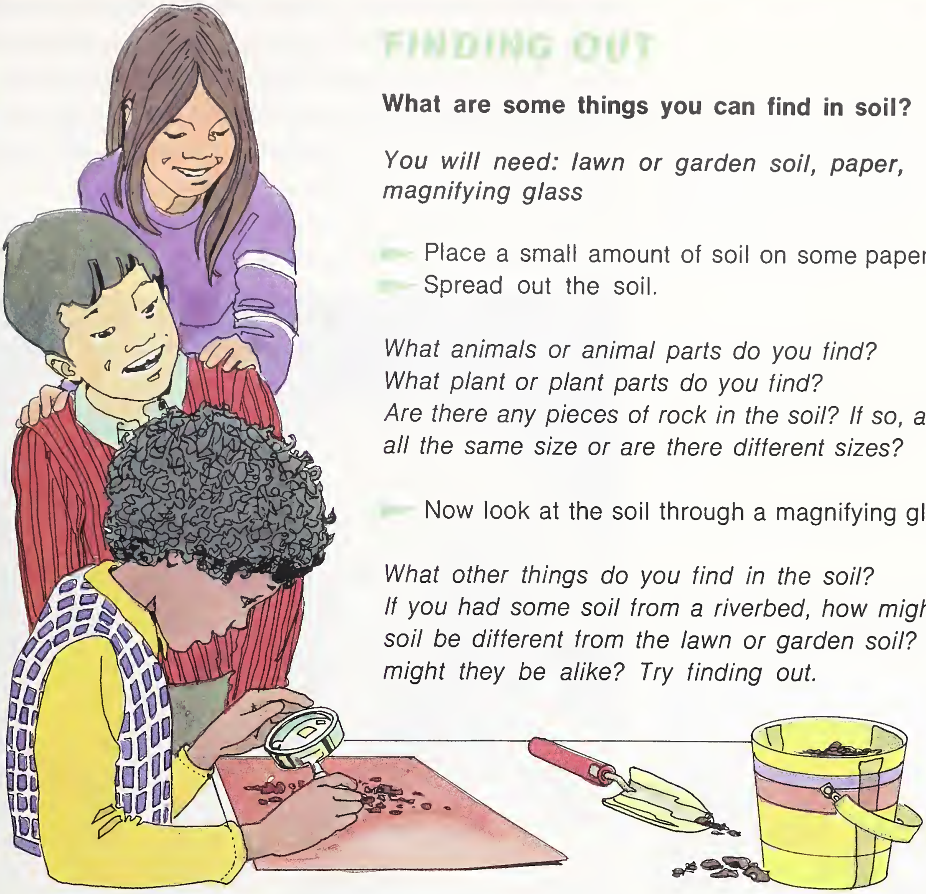
You will need: lawn or garden soil, paper, magnifying glass

- Place a small amount of soil on some paper.
- Spread out the soil.

What animals or animal parts do you find?
What plant or plant parts do you find?
Are there any pieces of rock in the soil? If so, are they all the same size or are there different sizes?

- Now look at the soil through a magnifying glass.

What other things do you find in the soil?
If you had some soil from a riverbed, how might this soil be different from the lawn or garden soil? How might they be alike? Try finding out.



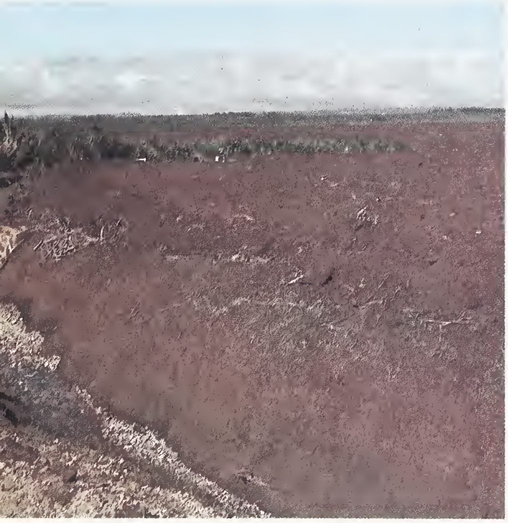
How are soils different from one another?

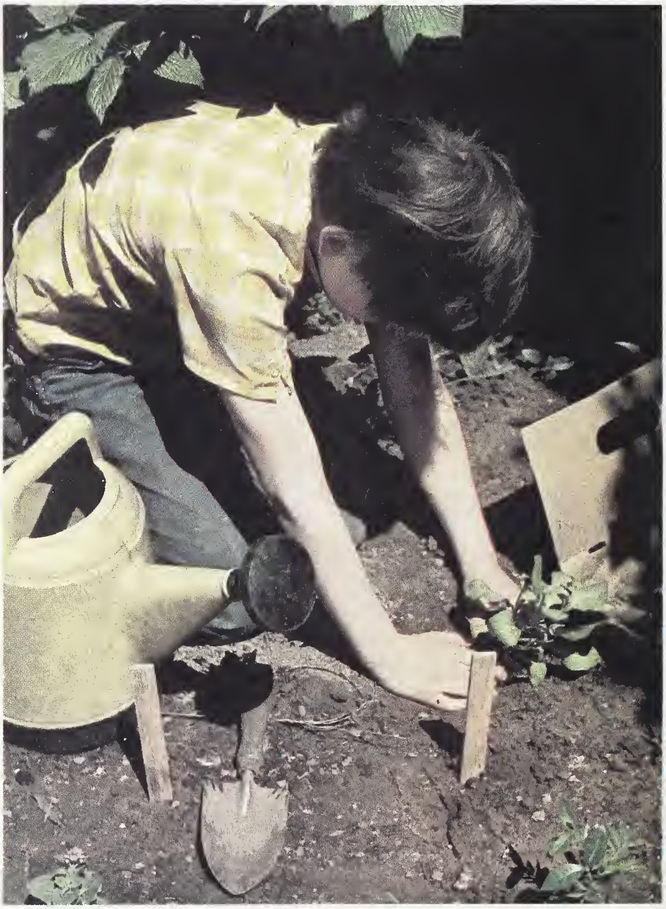
You may remember that rocks are different from one another in many ways. Soils are also different from one another.

Teaching helps for "Finding Out":
Processes used: observing, classifying, comparing, predicting.
Sample findings: The pupils will most likely observe a variety of animals, animal parts, plants, and plant parts in the soil. The pupils may also observe different-sized pieces of rocks in the soil. After the pupils look at the soil through a magnifying glass, they may observe very small pieces of rock and some very tiny animals and plants. The pupils may predict that if they were looking at soil from a riverbed, they might say that the pieces of rock in the soil are much smaller and that there are few, if any, plants and animals in the soil.

Colour. One way soils may differ is in their colour. Soils may differ in this way because of the things in them. Have you ever seen soil that is almost black? Or perhaps some that is light brown? Soil that is almost black is made up mostly of *humus* [HYOO-muhs]. Humus is the decaying parts of plants and animals. Soil that is light brown has very little or no humus in it.

Which soil do you think has more humus in it? Why?





Sample answers for the caption: The soil pictured on the right. Because its colour is closer to black than the colour of the soil pictured on the left.

Soils may also differ in colour because of certain minerals in them. One mineral may make soil look red. Another mineral may make soil look yellow. What are some soil colours you have seen?

Soil colour is important to people who grow plants. Why do you think this is so?[1]

Rock size. Soils are also different in another way. Suppose you had three buckets of soil. One was taken from a beach. Another was taken from a lawn or garden. And still another was taken from a riverbed. Now suppose you were to rub each kind of soil between your fingers. You would find that the soils feel different from one another. The soil taken from a beach would feel coarse, like sugar or salt. The soil taken from most riverbeds would feel fine, like scouring powder. Soil from a lawn or garden would have parts that feel coarse and parts that feel fine. Why do you think some soils would feel coarse and others would feel fine?[2]

People who grow plants know that the soil they use must be able to hold the right amount of air and water. Soil that is coarse can hold air. This is because of the large spaces between the pieces of rock in it. But coarse soil cannot hold water. Soil that is fine can hold water because of the small spaces between the pieces of rock in it. But fine soil cannot hold air. What kind of soil do you think plants would grow best in? Why? How might you find out?[3]

Chemicals. Soils differ in still another way. Soils have different kinds of chemicals in them.

You probably have some lemon juice or vinegar in your home. These things are examples of chemicals called *acids.* Soil which is made up mostly of humus may

[1] **Sample answer:** People can often tell if there is humus in the soil by looking at the colour of the soil.

[2] **Sample answer:** Because there are different-sized pieces of rock in different kinds of soils.

[3] **Sample answers:** A soil that can hold both air and water. Because plants need air and water to live. I could find out which soil would be best by trying to grow plants in each of the different kinds of soils.

Suggested activity: After the pupils have discussed the different colours of soil and the different-sized rocks found within soil, the pupils might collect as many different kinds of soil as they can find. Have the pupils identify each soil they collect by using a label which tells where they found each kind of soil. Have the pupils compare the soils according to colour and to rock size. Then you might have the pupils predict the soil or soils in which plants would grow best. Finally, you might have the pupils try growing a plant in each kind of soil to find out if their predictions were correct.

have a large amount of acid in it. When a soil is too acidic, most kinds of plants do not grow well in it.

Do you have some cleaners in your home that have ammonia in them? Ammonia is an example of chemicals called *bases*. Soil which is made from mostly limestone may be very basic. Most kinds of plants will not grow well in soil that is too basic.

People who grow plants know that the soil for most kinds of plants should be *neutral* [N(Y)OO-truhl]. That is, soil should be neither acidic nor basic. Because of this, people often add chemicals to their soil to make it neutral.

FINDING OUT

How can you find out whether the soils around you are basic, acidic, or neutral?

You will need: purple cabbage, dark-coloured soil, light-coloured soil, 2 jars with lids, strainer, 2 small glass jars, pan with lid, distilled water (from a grocery store), spoon

Although litmus paper is often used to test soil chemicals, purple-cabbage juice can also be used. Purple-cabbage juice will turn a shade of red when an acid is added to it. The juice will turn a shade of blue or green when a base is added to it. The juice will not change colour when something which is neutral is added to it.

- Break up some pieces of purple cabbage and put them in a pan. Cover the cabbage with distilled water.
- Put a lid on the pan and cook the cabbage for 15 minutes.
- Strain off the juice.
- Put some dark-coloured soil in one jar with a lid.
- Put some light-coloured soil in another jar with a lid.
- Fill both jars with distilled water, cap them, and shake.
- Let the soil settle in each jar for a few minutes.
- Put a few drops of the purple-cabbage juice into each small glass jar. Add a few drops of water from the dark-coloured soil jar to one of the small jars. Add a few drops of water from the light-coloured soil jar to the other small jar.

Are your soils basic, acidic, or neutral?
Would either of these soils be good for growing plants in?
Why or why not?

Teaching helps for "Finding Out":
Processes used: observing, experimenting, predicting.
Sample findings: The pupils will most likely observe that the dark-coloured soil is acidic and that the light-coloured soil is basic. The pupils may predict that neither soil would be better for growing plants. This might be so because one soil is acidic and one is basic. The best soil for most plants is that which is neutral.

Suppose you wanted to grow some plants. You would want to use the best kind of soil for your plants. What things might you do to make sure you have the best kind of soil?[1]

[1] **Sample answer:** I could check the soil colour. I could check the soil to see if it can hold both air and water. I could also check the soil to find out whether it is acidic, basic, or neutral.

A Second Look

1. Why is soil important?
2. What things are important in the makeup of soil?
3. In what ways are soils different from one another?

Sample answers for "A Second Look": 1. Soil is important because most of the food people eat and the clothing people wear come from plants grown in soil or from animals that are raised on plants grown in soil. 2. Rocks, minerals, plants, animals, air, and water are things that are important in the makeup of soil. 3. Soil differs in colour, in rock size, and in chemical makeup.

4 How can land be used wisely?

You most likely know that many of the things people use come from the land. Because of this, it is important for people to find ways of *conserving* [kuhn-SURV-ihng], or saving, the land. In what ways might people conserve the land?[1]

[1] **Sample answer:** Plant trees, grass, and other plants in places where the land is bare, so the land does not blow away.

Conserving soil

Have you ever seen a road being built? Or perhaps a building? If you have, you know that trees and grass growing on the land are often removed. When this happens, the soil around these roads and buildings is more easily blown or washed away. But people have

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Main concepts of the chapter (pages 231–235):
It is important for people to conserve soil, minerals, and fossil fuels.
There are many ways people can conserve soil, minerals, and fossil fuels.

Performance objective: After studying the information provided in this chapter, the pupils should be able to
—list some ways people can conserve soil, minerals, and fossil fuels.

Important words: conserving, recycling, substitutes, fossil fuels.

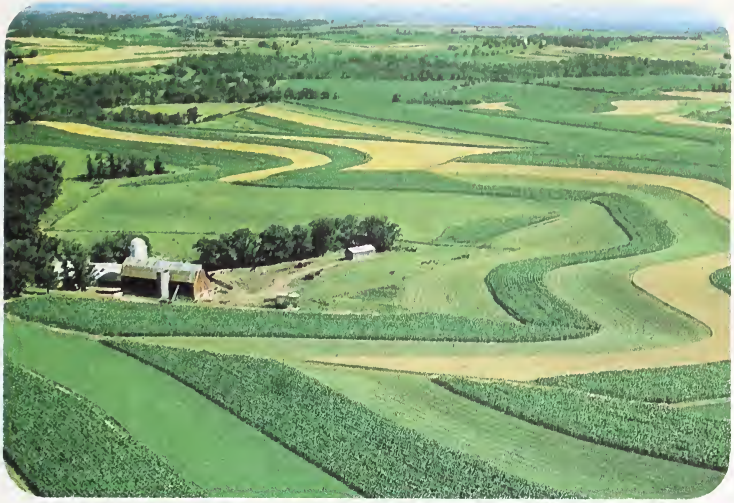
found a way to conserve soil in these places. They do this by replanting trees and grass around roads and buildings. In what way might replanting help conserve soil?[1]

You know that many things people use are made from wood. So, a great number of trees must be cut down. For many years, people would cut down a whole forest. But people discovered that when a large area of land is cleared, wind and rushing water can carry the soil away more easily. Now, only a part of a forest is cut down at one time. Also, people plant small trees in place of the ones that are cut down. How might doing these things help conserve soil?[2]

[1] **Sample answer:** It would keep soil from being carried away by wind or by rushing water.

[2] **Sample answer:** It would keep large areas of land from being cleared of all plants and therefore keep the soil from being carried away by wind or by rushing water.

Suggested activity: After discussing the replanting of trees and grass as a way of conserving soil, the pupils might look for places around their school where soil is being carried away. Then you might have the pupils write proposals for what could be done to help conserve the soil in these places.



Some other ways farmers help conserve soil are by plowing along the slopes of hills as shown and by planting different crops in strips. How would doing these things help conserve soil?

There is another way people have learned to conserve soil. For many years, farmers planted the same crops in the same soil year after year. In time, most of the minerals these crops needed were used up. When this happened, crops could not grow in the soil. Because of this, the soil was more easily carried away by wind and rushing water.

Farmers learned that they could keep this from happening by planting a different kind of crop in their soil each year. That is, one year they might plant corn, which uses up the nitrogen in the soil. The next year they might plant beans, which puts nitrogen back into the soil. In this way, farmers are able to conserve their soil.

There is still another way in which people have learned to conserve soil. This is by adding fertilizer to the soil. How might the use of fertilizer be helpful in conserving soil?[1]

[1] **Sample answer:** Fertilizer puts minerals back into soil so crops can be grown in the soil. The crops help keep the land from being carried away by wind or by rushing water.

Sample answer for the caption: Plowing around the slopes of hills keeps soil from being carried away by rushing water. Planting different crops in strips helps keep soil from being carried away by wind.

Conserving minerals

Do you have any aluminum cans or glass bottles in your home? These things, as you may know, are made from minerals. After aluminum cans and glass bottles are used, people often throw them away. These things then become a part of the tons of trash that are thrown away each year. But there are places which collect aluminum cans and glass bottles. These places then melt them down and make new cans and bottles. This is called *recycling* [ree-SY-k(uh-)lihng]. Do you think that recycling is a way of conserving minerals? Why or why not?[1]

For You to Think About

Paper is another thing which can be recycled. Why do you think it would be important to recycle paper?

[1] **Sample answers:** Yes. Because the same minerals can be used again and again.

Sample answer for "For You to Think About": Because paper is made from trees. It is important to conserve trees because they can be used up faster than they can be grown.
Suggested activity: After the pupils have discussed recycling as a way of conserving minerals, they might find out if there are any recycling centres within their community, and if so, you might have the pupils find out how they might go about making use of such a centre.

Another way people have learned to conserve minerals is by using *substitutes* [SUHB-stuh-T(Y)OOTS]. Substitutes are things made from something other than minerals. For example, plastic cups and plates are substitutes for glass cups and plates. Glass cups and plates, as you may know, are made from the mineral quartz. What are some other things you use that are substitutes for minerals?[1]

[1] **Sample answer:** Anything made from wood or plastic.

Conserving fossil fuels

There are other things which people use from the land. They are called *fossil fuels*. Oil, coal, and natural gas are fossil fuels. Oil and coal are used to make electricity. Oil and natural gas are used to heat homes. It is important to conserve these fuels because the earth's supply of these fuels is limited. What things might you do in your home to help conserve fossil fuels?[2]

One way people have learned to conserve fossil fuels is by using other things for power. People have learned that they can make electricity by using waterpower and atomic power. People are also trying to find ways of using the sun as a source of power. Why might the sun be a good source of power?[3]

Exploring on Your Own

See if you can find out why people call oil, coal, and natural gas *fossil fuels*.

[2] **Sample answer:** Turn off lights and appliances when I am not using them. Use less hot water when taking a bath or a shower and when washing dishes.

[3] **Sample answer:** Because the sun's power cannot be used up, as fossil fuels can be.

A Second Look

1. How can soil be conserved?
2. How can minerals be conserved?
3. How can fossil fuels be conserved?

Sample answers for "A Second Look": 1. Soil can be conserved by replanting trees and grass in areas where the land has been cleared. Soil can also be conserved by planting a different kind of crop in the same soil each year and by adding fertilizer to the soil. 2. Minerals can be conserved by recycling things made from certain minerals and by using substitutes for minerals. 3. Fossil fuels can be conserved by using other things for power and by trying to find ways of using the sun as a source of power.

Sample finding for "Exploring on Your Own": They are called fossil fuels because they are made from the decayed parts of plants and animals which lived millions of years ago.

There are many people who study the earth. They do this to find out more about rocks, minerals, and other things found in the earth. Some people who study the earth are called *geologists* [jee-OL-uh-juhsts].

There are many different kinds of geologists. One kind of geologist studies fossils. This helps people know more about the age of the earth and about the kinds of plants and animals that once lived on the earth.

Another kind of geologist studies the earth to find coal, oil, and natural gas. Why might finding these fuels be important to people?

Still another kind of geologist studies the chemical makeup of rocks and minerals. This kind of geologist does this to learn more about how these rocks and minerals are formed. This geologist also studies rocks and minerals to find new uses for them.

To find out more about the work of geologists, try finding the answers to these questions:

What are some other kinds of geologists, and how is their work helpful to people? [1]

What are some of the tools that geologists use in their work? [2]

Along with using sources of your own, writing to the following source may be helpful: Geological Association of Canada, Department of Earth Sciences, University of Waterloo, Waterloo, Ontario N2L 3G1.

This geologist is taking a sample of rock which contains the mineral sulphur. He will take many samples from this area before studying the rocks. Why do you suppose a geologist takes more than one sample?

Sample answers for "Workers Who Use Science":

[1] Another kind of geologist studies the layers of rocks of the earth. This kind of geologist does this to help find out the age and the history of the earth. Still another kind of geologist studies the earth's surface. This kind of geologist does this to find out how the surface of the earth was formed and how it changes.

[2] A geologist uses tools such as maps, picks, hammers, microscopes, and certain chemicals.

Sample answer for the caption: So he can tell how large the deposit is and how pure the deposit is.

Reviewing the Main Ideas

There are many forces which change the land. These forces include rushing water, rain, plants, freezing water, wind, pressure, and heat.

The earth may be thought of as having three main parts—the crust, the mantle, and the core.

It is thought that the crust is made up of large pieces of rock called plates. These plates are thought to be moving about slowly.

Rocks are made up of minerals.

Many things you use every day are made from minerals.

Rocks are different from one another because of how they are formed and because of the different minerals in them.

Most of the food people eat and the clothing people wear comes from plants grown in soil or from animals that are raised on plants grown in soil.

Many things are important to the makeup of soil. These things include rocks, minerals, plants, animals, air, and water.

Soils are different from one another in many ways.

There are many things people can do to conserve soil, minerals, and fossil fuels.

Reading About Science

Klaits, Barrie. *When You Find a Rock: A Field Guide.* Cambridge, Ontario: Collier Macmillan Canada Ltd., 1976.

Nixon, Peter. *A Better World?* Toronto, Ontario: Macmillan Company of Canada Ltd., 1975.

Rhine, Richard. *Life in a Bucket of Soil.* Agincourt, Ontario: Gage Publishing Limited, 1972.

Wyler, Rose and Ames, Gerald. *Secrets in Stones.* Richmond Hill, Ontario: Scholastic-TAB Publications Ltd., 1972.

Reviewing the unit: You may wish to have the pupils study "Reviewing the Main Ideas" to help prepare for "Testing for Understanding" found on page 238.

For further reading: You may wish to encourage the pupils to read the books listed under "Reading About Science" and other books and articles related to the changing land. Such articles may be found in reference books under the headings *erosion, weathering, minerals,* and *soil.*

Testing for Understanding

Ideas to Check

On your paper write *T* for each sentence below that is true. Write *F* for each sentence that is false.

T 1. There are many forces which change the land.
T 2. A fault is a folding or cracking of the crust of the earth.
F 3. There are only a few things people use which are made from minerals.
F 4. Most fossils are found in metamorphic rocks.
T 5. Rocks, minerals, plants, animals, air, and water are important to the makeup of soil.
T 6. Nitrogen is a gas plants need to live.
F 7. People have found that there is little they can do to help conserve land.

Words to Use

Write on your paper the word that best fits in each blank below. Choose from these words: *mantle, crust, core, sedimentary, igneous, humus, recycling, acids, bases.*

1. When hot gases and molten rock break through the ——, a volcano is formed. crust
2. It is thought that pressure within the earth causes part of the —— and the —— to be molten. mantle; core
3. Rock which is made layer by layer is called —— rock. sedimentary
4. Granite and lava are called —— rocks. igneous
5. The decaying parts of plants and animals found in soil is called ——. humus
6. Many minerals can be conserved by ——. recycling

Suggestions for evalution: You may wish to use the test questions provided under "Testing for Understanding" to evaluate the pupils' understanding of the main ideas and important words of this unit. Additional test questions for the unit "The Changing Land" are provided for you on page T20 of the Teacher's Manual. These test questions may be duplicated for classroom use. Answers to these additional test questions can be found on page T22 of the Teacher's Manual.

Having Fun with Science

Mystery Words

Below is a list of words. The letters in each word can be rearranged to spell out a word that is in *italics* in this unit. For example, if the word "pleat" was listed below, it could be rearranged to spell "plate."

milestone	limestone	gamma	magma
leash	shale	ramble	marble

What Am I?

I am something you cannot see,
but plants are always in need of me.[1]

Many people look for me
in rocks that are called sedimentary.[2]

Things to Do

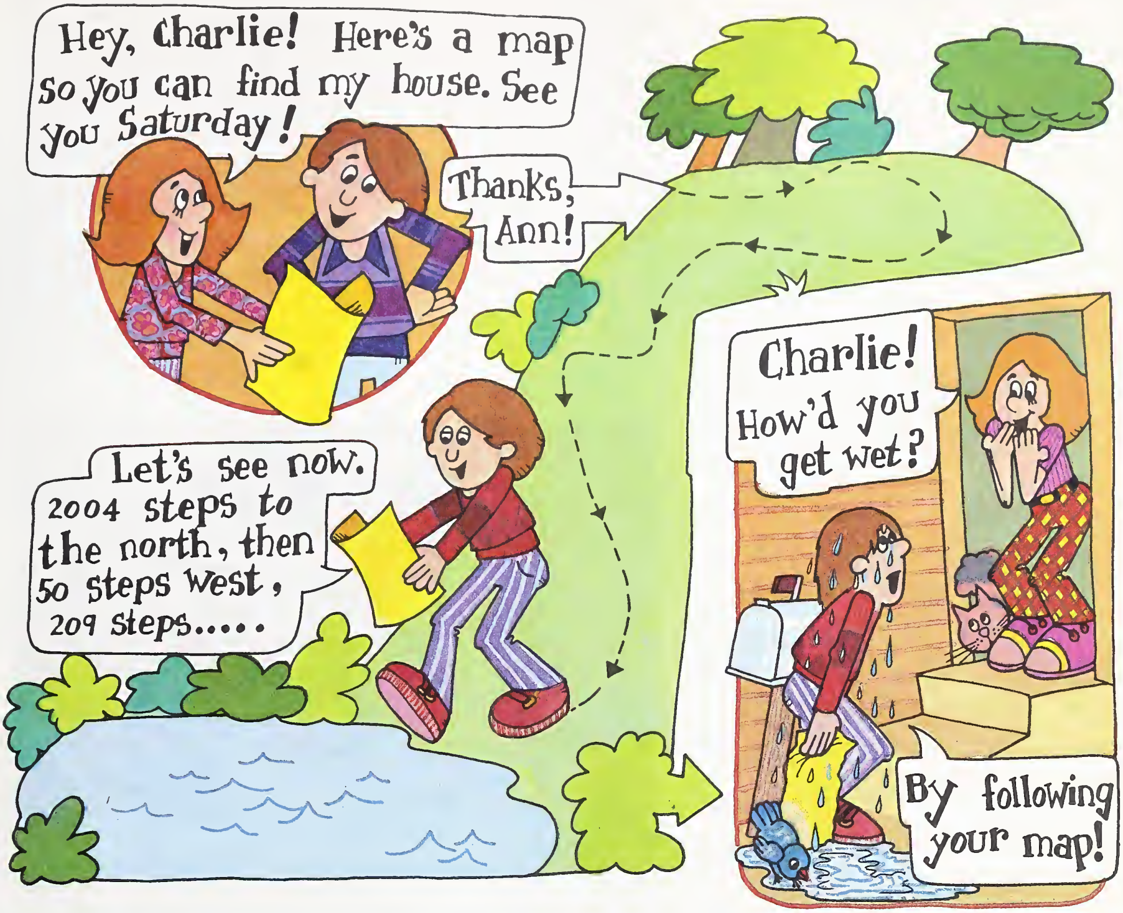
1. Make a rock, mineral, and fossil collection. Ask someone such as a rock collector or a person who works in a museum where it would be best to look for these things. See how many different kinds of rocks, minerals, and fossils you can find.
2. Look in newspapers and magazines for pictures of places where soil is being carried away by wind and rushing water. Make a list of things that could be done to help conserve this soil.

For further involvement: You may wish to use "Having Fun with Science" to involve the pupils in fun activities which reinforce some of the main concepts of the unit "The Changing Land." You may also wish to encourage the pupils to make up additional activities related to the changing land. **Answers for "What Am I?":** [1] Nitrogen. [2] Fossils.

6 Mapping the Earth

1 **Looking at maps**
2 **Reading maps**
3 **Using maps**

Preparing for the unit: For a list of instructional materials helpful in teaching this unit, see pages T14–T15 of the Teacher's Manual. You may wish to check the list of materials needed for each "Finding Out" activity in this unit and have the pupils begin collecting these materials. These activities are found on pages 245, 248, 251, 262, and 265.


Hey, Charlie! Here's a map so you can find my house. See you Saturday!
Thanks, Ann!
Let's see now. 2004 steps to the north, then 50 steps west, 209 steps.....
Charlie! How'd you get wet?
By following your map!

What do you think the problem was with Ann's map?[1]

What are some of the ways maps are helpful to people?[2]

When have you used a map?

Introducing the unit: You may wish to have the pupils read the cartoon above. Then have the pupils read the questions below the cartoon and discuss their answers to the questions.

Sample answers for questions below the cartoon:

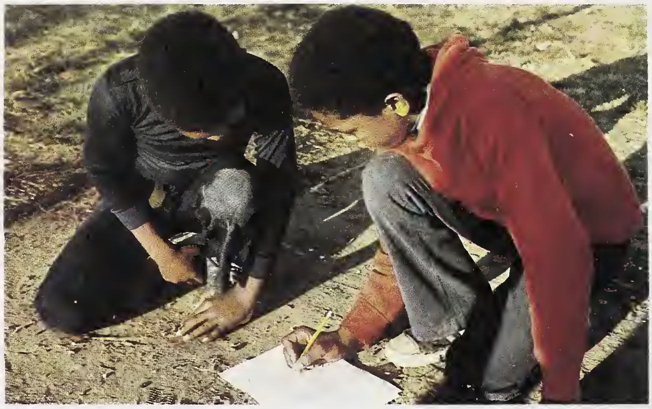
[1] Ann didn't realize that most people do not take the same length of steps when they walk. Therefore, measuring distances by steps is not a very good way of measuring.

[2] People can use maps to help them find their way from one place to another. People can also use maps to find out what the land is like in different places.

1 Looking at maps

Suppose you want to invite a friend to your home. And suppose your friend has just moved into town and does not know where you live. There are many things you could do to make sure your friend finds your home. One thing would be to have your friend go home with you after school. But suppose your friend could not go until later. Then you might tell your friend how to get to your home. Or you might draw a map for your friend. Which of these things do you think would be the most helpful to your friend? Why? [1]

[1] **Sample answers:** Draw a map. Because it would be easier for my friend to use a map to find my home than it would be for my friend to remember the directions I would tell my friend.



What is a map?

Many people use maps. You probably have used maps from time to time. But what if you were asked what a map is. Might you say that a map is a drawing of an area of land? Or might you say that a map is a drawing that shows ways of getting from one place to another? What other things might you say that would explain what a map is? [2]

[2] **Sample answer:** A map might show the kind of land that is in a certain area. A map might also show sea routes or air routes.

Main concept of the chapter (pages 242–245): There are many different kinds of maps.

Performance objective: After studying the information provided in this chapter, the pupils should be able to

—list three different kinds of maps and explain how the information found on each kind of map might be helpful to people.

Important word: map.

Why are maps important?

You probably know that some maps are important because people use them to find their way from one place to another. But maps are important for other reasons.

People often use maps to find out how long it might take to travel from one place to another. Weather forecasters use maps to help show what the weather is going to be like. Do you think that maps are important to people who plan streets and highways? Why or why not?[1]

For You to Think About

Television newscasters often use maps during a news program. How might this be helpful to people?

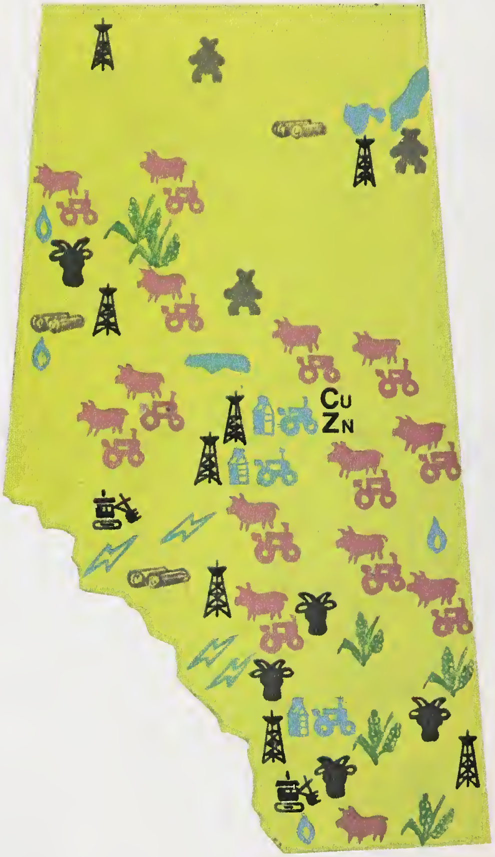
[1] **Sample answers:** Yes. Because these people could use maps to plan streets or highways that would help people travel more easily and more quickly from place to place.

What are some different kinds of maps?

Suppose you want to plan a trip across town. You most likely would look at a street map. But suppose you want to plan a trip to a different country, such as Australia. You probably would look at a globe.

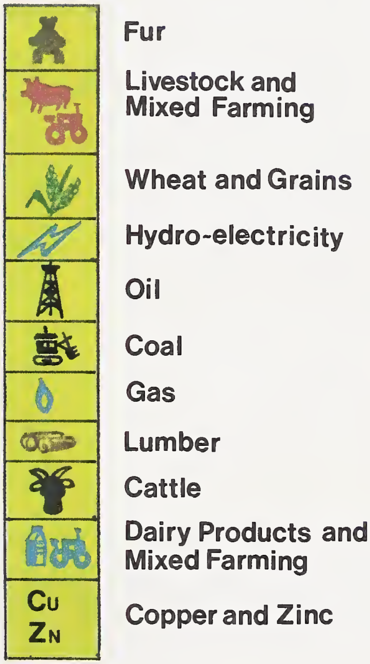
Sample answer for "For You to Think About": These maps point out the location of places the newscaster is talking about.

There are many other kinds of maps besides street maps and globes. One kind of map shows what the surface of an area of land is like. Another kind of map shows how much rain falls in an area during a certain length of time. How might the information found on each of these kinds of maps be helpful to people?[1]



SOME PRODUCTS OF ALBERTA

What kinds of information are shown on this map?



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[1] **Sample answer:** A map that shows what the surface of an area of land is like might be helpful to people when building a road or planning a city. A map that shows how much rain falls in an area during a certain time might be helpful to people when deciding what kinds of crops to grow.

Sample answer for the caption: The map shows some of the major products of Alberta and the area of Alberta in which each product is most commonly produced.

Suggested research and discussion: After looking at the map above, the pupils might use reference books to find a product map of the province in which they live. You might then have the pupils discuss their answers to the following questions: What products are produced in your province? In what area is each kind of product most commonly produced?

FINDING OUT

What information can you get from different kinds of maps?

You will need: newspaper, news magazine, 1 volume of an encyclopedia

► Look through the newspaper, the news magazine, and the encyclopedia for different kinds of maps.

How many different kinds of maps did you find? What information did each kind of map give you? How might this information be helpful to people?

A Second Look

1. What is a map?
2. What are some ways in which people use maps?
3. What are some examples of different kinds of maps?

Teaching helps for "Finding Out":
Processes used: observing, communicating, interpreting data.
Sample findings: The pupils will most likely find maps such as weather maps, product maps, rainfall maps, and elevation maps. The information the pupils get from these maps will vary.
Sample answers for "A Second Look": 1. A map is a drawing of an area of land that may show certain things such as ways of getting from one place to another, what the weather may be like in a certain area, or what the surface of an area of land is like. A map may also show how much rain falls in an area during a certain length of time or what products are made in a certain area. 2. People might use maps to find their way from one place to another or to find out how long it might take to travel from one place to another. 3. Some examples of different kinds of maps are street maps and weather maps.

2 Reading maps

You know that when you talk, read, or write, you use words that are part of a certain language. There are many different languages which people use. In fact when people make or use a map, they use a kind of language. What things do you think make up the language of maps?[1]

[1] **Sample answer:** Symbols, colours.

Symbols

You most likely know that = means equals. And that ? means a question is being asked. Things such as = and ? are called *symbols* [SIHM-buhlz]. Symbols are signs used in place of words. Symbols help make up the language of maps. What are some map symbols you know of?[2]

[2] **Sample answer:** Railroads, airports, highways, rivers.

Main concepts of the chapter (pages 246–256):

Symbols, colours, scales, and grids are some of the things which make up the language of maps.

Symbols are used on maps to represent certain things.

Colours are used on maps to point out certain things.

Most maps are drawn to scale.

Grids are used on maps so that people can find places on these maps more easily.

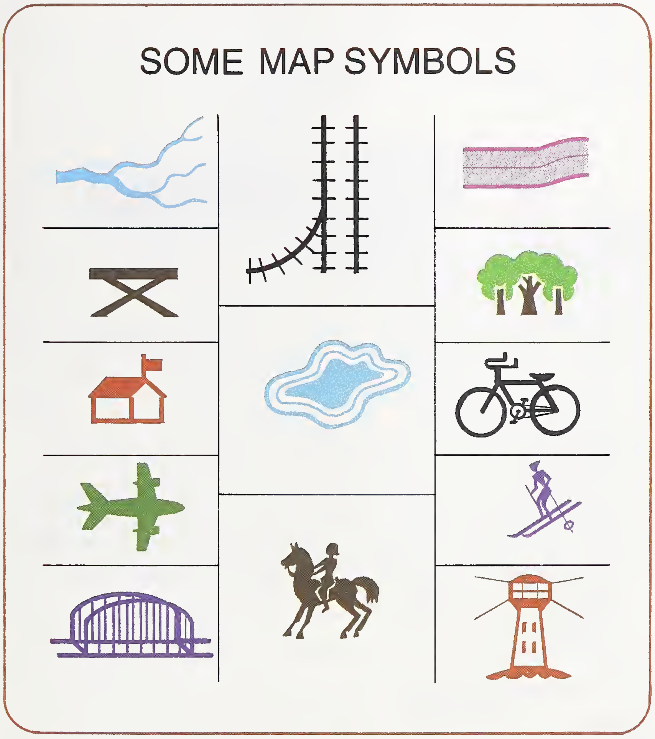
Performance objective: After studying the information provided in this chapter, the pupils should be able to

—list four things which help make up the language of maps and explain how each of these things is used on maps.

Important words: symbols, legend, colours, elevation, scale, grid, reference point, parallels, meridians, degrees, equator, prime meridian, international date line.

Most symbols used on maps look like the things they represent, or stand for. Below is a picture of some symbols. These symbols are often used on maps. What do you think each symbol represents?[1]

Sometimes symbols used on maps do not look like the things they represent. The symbols used to represent cities do not look like cities. Instead, these symbols are usually circles or dots. You can find out what a symbol represents by looking at the *legend* [LEHJ-uhnd], or list of symbols used on a map. Why do you think symbols rather than pictures are used on maps?[2]



Exploring on Your Own

Symbols which represent cities often give people information about these cities. Look at a legend on a road map and see if you can find out what information these symbols give.

[1] **Sample answer:** River, picnic area, school, airport, bridge, railroad, lake, bridle path, highway, park, bike path, ski area, lighthouse.

[2] **Sample answer:** Symbols take up less room than pictures do.

Sample findings for "Exploring on Your Own": These symbols usually give the population of the cities they represent. These symbols also point out a county seat or a provincial capital.

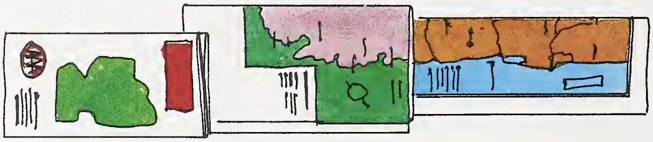
FINDING OUT

What are some different symbols you can find on maps?

You will need: provincial road map, city map

- Look at the maps carefully. Look for some symbols that are the same on both maps.
- Look for some symbols that are used on one map but not on the other map.

Are there some symbols that are the same on both maps? If so, what are some of these symbols?
Are there some symbols that are used on one map but not on the other map? If so, what are some of these symbols?
Why do you think different symbols are often used on different maps?



Colours

Colours also help make up the language of maps. You probably have seen a map of Canada in which the provinces are coloured differently from one another. Colours are used on many maps to show different kinds of things. Some of these things include countries, provinces or counties. Why might the use of colours in this way be helpful to people when reading a map?[1]

[1] **Sample answer:** It helps people see the boundaries of countries, provinces, or counties more quickly.

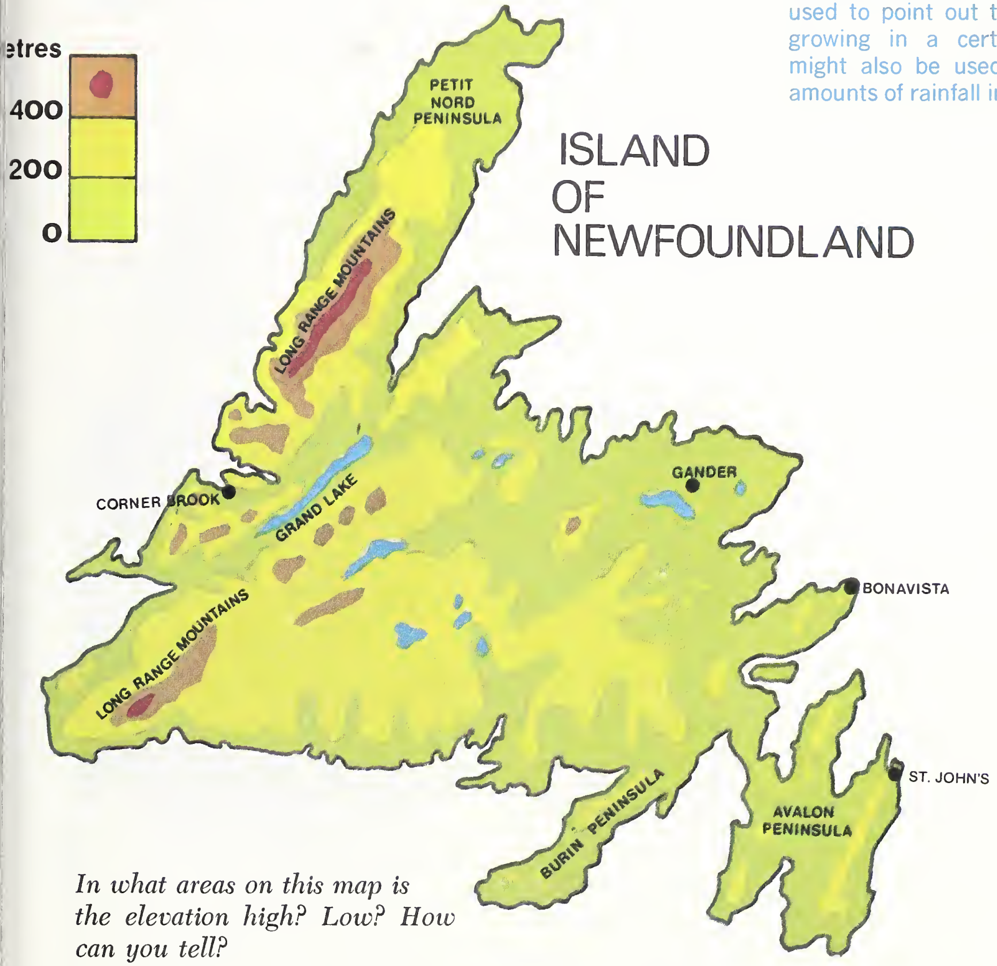
Teaching helps for "Finding Out":
Processes used: observing, comparing, communicating, inferring.
Sample findings: The pupils will most likely observe that both maps have the same or similar symbols for railroads, highways, lakes, and rivers. The pupils may also observe that the city maps have symbols showing parks, hospitals, libraries, and other local points of interest, whereas provincial maps usually have symbols which point out things such as provincial or national parks and other provincial or national points of interest. The pupils may infer that different symbols are often used on different maps because each map is made to highlight different points of interest.

Colours are also used to show what the surface of an area of land is like. For example, colours are often used to show the *elevation* [EHL-uh-VAY-shuhn], or height, of an area of land. The map on this page shows how colours can be used in this way.

Colours are used on maps to point out many other things. What might some of these things be?[1]

There is a special kind of map called a *contour map.* A contour map shows land elevations without the use of colours. Try finding out how a contour map shows land elevations.

[1] **Sample answer:** Colours might be used to point out the kinds of plants growing in a certain area. Colours might also be used to point out the amounts of rainfall in a certain area.



In what areas on this map is the elevation high? Low? How can you tell?

Sample finding for "Exploring on Your Own": A contour map shows land elevation by means of a series of lines. Each line on the map shows the places on the surface of the land which are the same elevation.

Sample answers for the caption: Any of the areas coloured the same as the colour in the legend representing over 400 m. Any of the areas coloured the same as the colour in the legend representing 0 m to 200 m. I can tell by matching the colours on the map with those in the legend.

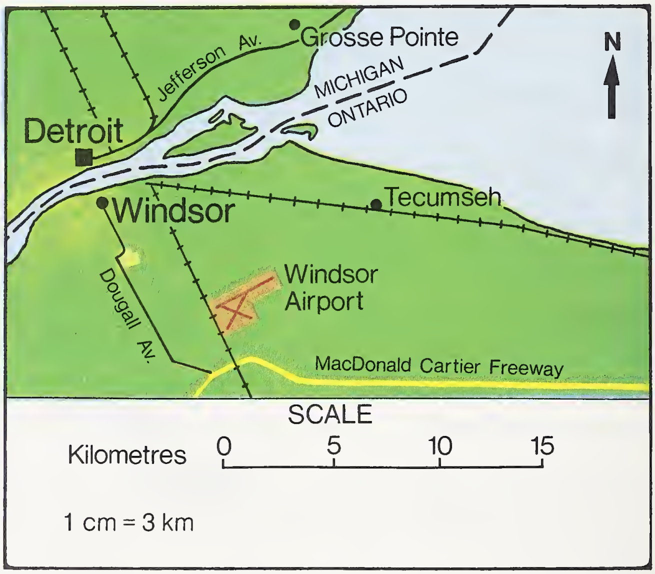
Scales

Besides symbols and colours, there is something else which helps make up the language of maps. Have you ever seen measurements on a map, such as 1 cm equals 100 km? If so, then you have seen a map drawn to *scale*. In this case, 1 cm on the map represents 100 km on the surface of the earth.

Most maps are drawn to scale. This is done so that large areas that might cover thousands of square kilometres on the surface of the earth can be shown on a map. Why might this be helpful to people when reading a map?[1]

Suppose you want to draw a map of your classroom to scale. And suppose your classroom is about 18 m long and about 12 m wide. You would need to decide on a measurement you could use to draw your map to scale. For example, you might say that 1 cm

[1] **Sample answer:** People can study a large area of land at a glance.



Using the bar scale, find out about how far it is from Windsor to other cities on the map.

Sample answer for the caption: Windsor is about 2.5 km from Detroit. Grosse Pointe is a little more than 12 km from Windsor. Tecumseh is a little more than 12 km from Windsor.

on the map equals 1 m of your classroom. If you did, you would represent the length of your classroom by drawing a line 18 cm long. You would then represent the width of your classroom by drawing a line 12 cm long. But suppose you chose the measurement 1 cm equals 2 m. Would this map be different from the map in which you used 1 cm equals 1 m? If so, how?[1]

[1] **Sample answers:** Yes. The map drawn to the scale 1 cm equals 2 m would be exactly half the size of the map drawn to the scale 1 cm equals 1 m.

FINDING OUT

How can you make a map of your classroom?

You will need: paper, pencil, measuring stick

- Measure the length and the width of your classroom.
- Write down the measurements.
- Choose a scale, and draw a map of your classroom to scale. Be sure to write on your map the scale you are using.
- Measure your teacher's desk, any tables, and your desk. Draw these things on your map to scale.

What other things in your classroom might you put on your map? What would you need to do to draw these things to scale on your map?

- Compare your map with the maps made by others in your class.

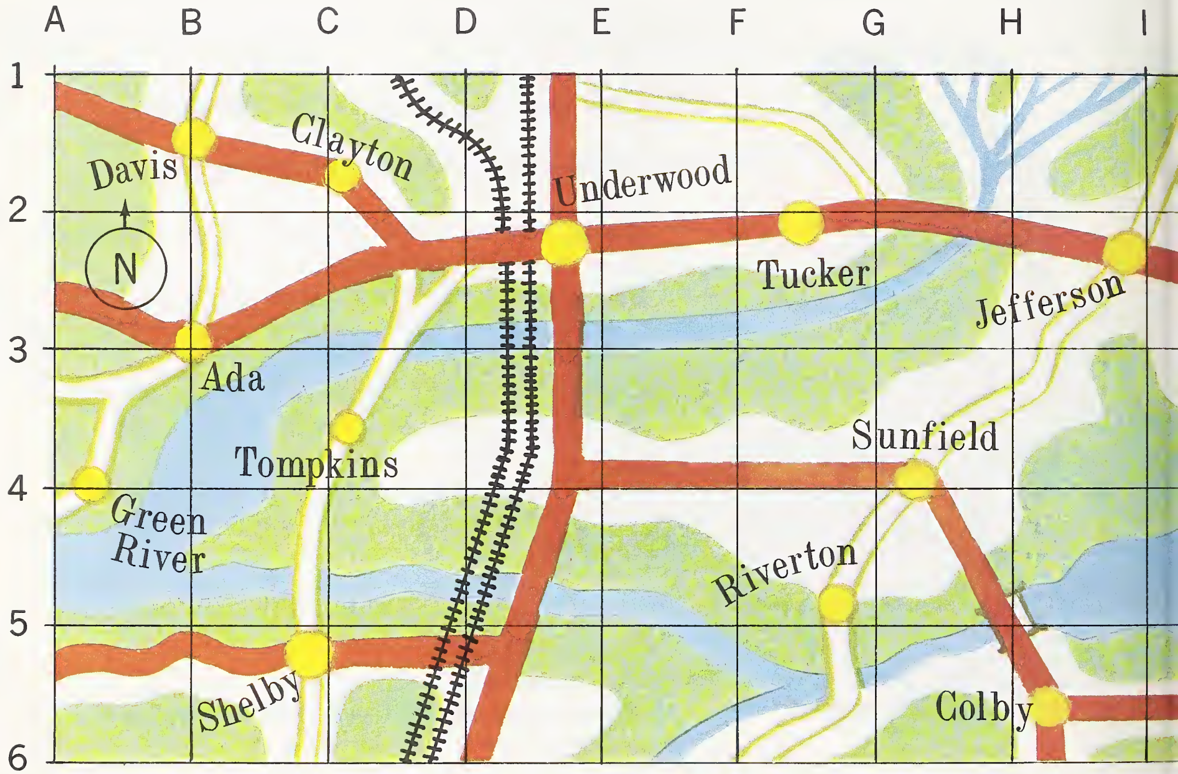
Do all your maps look the same? Why or why not?

Teaching helps for "Finding Out":
Processes used: observing, measuring, using numbers, comparing, communicating, inferring. *Sample findings:* The pupils will most likely include such things as windows, doors, chalkboards, and bulletin boards. The pupils may then state that they will need to measure these additional things so they can be drawn to scale on the pupils' maps. When the pupils compare their maps, they will most likely observe that all the maps do not look the same. They may infer from this observation that everyone did not use the same scale when drawing their map.

Grids

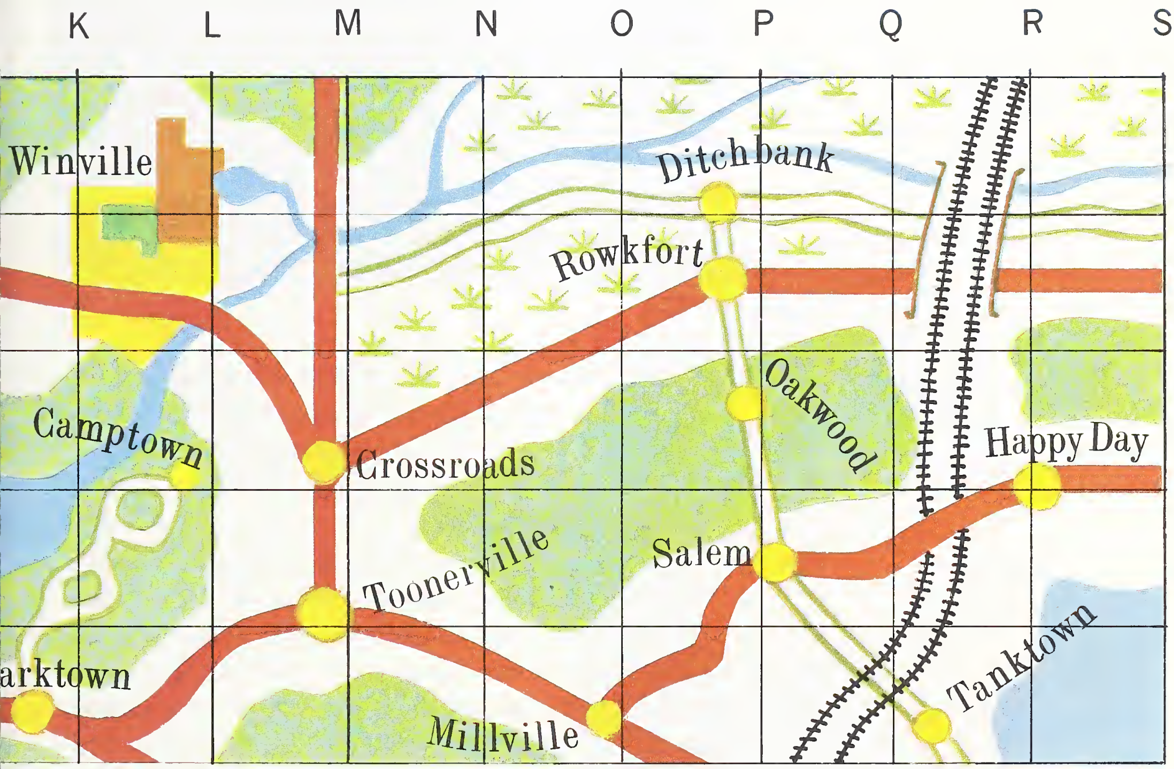
A city called Happy Day is located on the map below. See if you can find this city. How long did it take you to find Happy Day? How did you go about finding Happy Day?

Still another thing which helps make up the language of maps is a *grid*. A grid is made up of lines which can be used to find places on a map. Some of these lines run north and south on a map. These lines are usually



lettered. There are also lines which run east and west on a map. These lines are usually numbered.

The point at which a lettered line and a numbered line cross is called a *reference point*. When you looked for the city called Happy Day on the map below, you had no reference point. Therefore, you probably took several seconds to find Happy Day. Now try to find the city called Ada. It is located near the point where line B and line 3 cross. Which city was easier to find, Happy Day or Ada? Why?[1]



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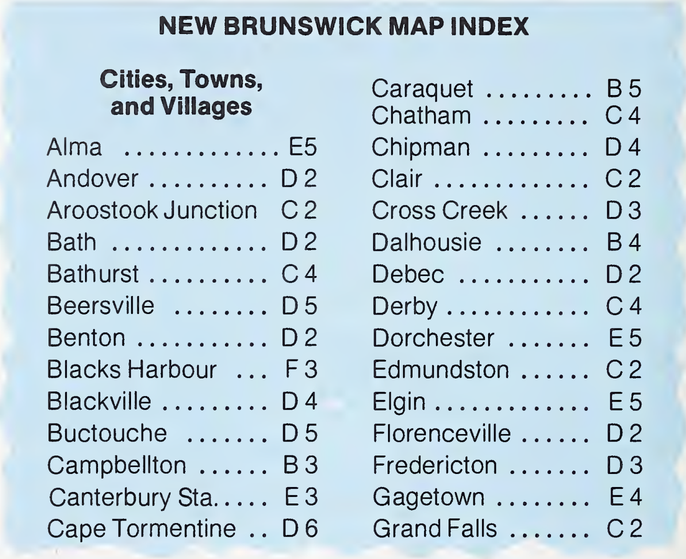
[1] **Sample answers:** Ada. Because all I had to do was look for the place where line B and line 3 crossed.

Suggested activity: After the pupils have found the cities of Happy Day and Ada, you might have them practice giving the reference lines for the following cities: Clayton, Underwood, Shelby, Crossroads, and Toonerville. (Sample answers: C2, E2, C5, M4, and M5.) After the pupils have completed this activity, you might have them bring in road maps or use maps in reference books to practice using reference lines to locate other places. (You may note that the maps your pupils bring in may not have the reference lines drawn in.)

Most maps give a list of cities shown on the map. The list also gives the reference lines for locating these cities. The picture on this page shows such a list.



NEW BRUNSWICK MAP INDEX

Cities, Towns, and Villages	
Alma	E5
Andover	D 2
Aroostook Junction	C 2
Bath	D 2
Bathurst	C 4
Beersville	D 5
Benton	D 2
Blacks Harbour	F 3
Blackville	D 4
Buctouche	D 5
Campbellton	B 3
Canterbury Sta.	E 3
Cape Tormentine	D 6
Caraquet	B 5
Chatham	C 4
Chipman	D 4
Clair	C 2
Cross Creek	D 3
Dalhousie	B 4
Debec	D 2
Derby	C 4
Dorchester	E 5
Edmundston	C 2
Elgin	E 5
Florenceville	D 2
Fredericton	D 3
Gagetown	E 4
Grand Falls	C 2

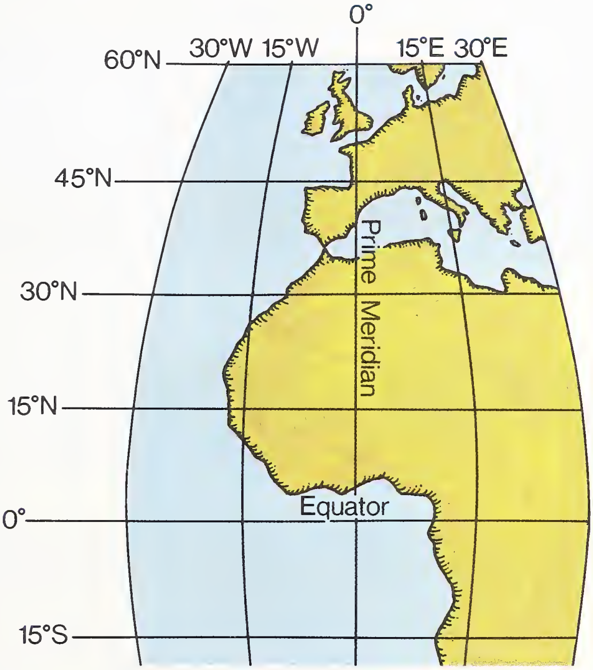
Although some maps use lettered and numbered reference lines, other maps use reference lines called *parallels* [PAR-uh-LEHLZ] and *meridians* [muh-RIHD-ee-uhnz]. Parallels and meridians are marked by *degrees.* The symbol for degrees is °.

One parallel you most likely know of is the *equator.* You probably know that the equator is a line which runs east and west around the earth. Therefore, the equator divides the earth into a northern half and a southern half. The equator is marked 0°. The farthest parallel north of the equator is marked 90°N. The farthest parallel south of the equator is marked 90°S.

Meridians on a map run north and south. There is only one meridian which is marked 0°, just as there is only one parallel marked 0°. This meridian is called the *prime meridian*. A meridian which is ten degrees east of the prime meridian is marked 10°E. A meridian which is ten degrees west of the prime meridian is marked 10° W. The farthest meridian to the east and the farthest meridian to the west is the same meridian. It is marked 180°. This meridian is called the *International Date Line*.

Suppose you are traveling west toward the International Date Line. And suppose you approach the International Date Line on a Sunday. When you cross this line, the day would be Monday. Now suppose you are traveling east toward the International Date Line. And suppose you approach the International Date Line on Monday. What day do you think it would be after you cross this line? [1]

[1] **Sample answer:** Sunday.



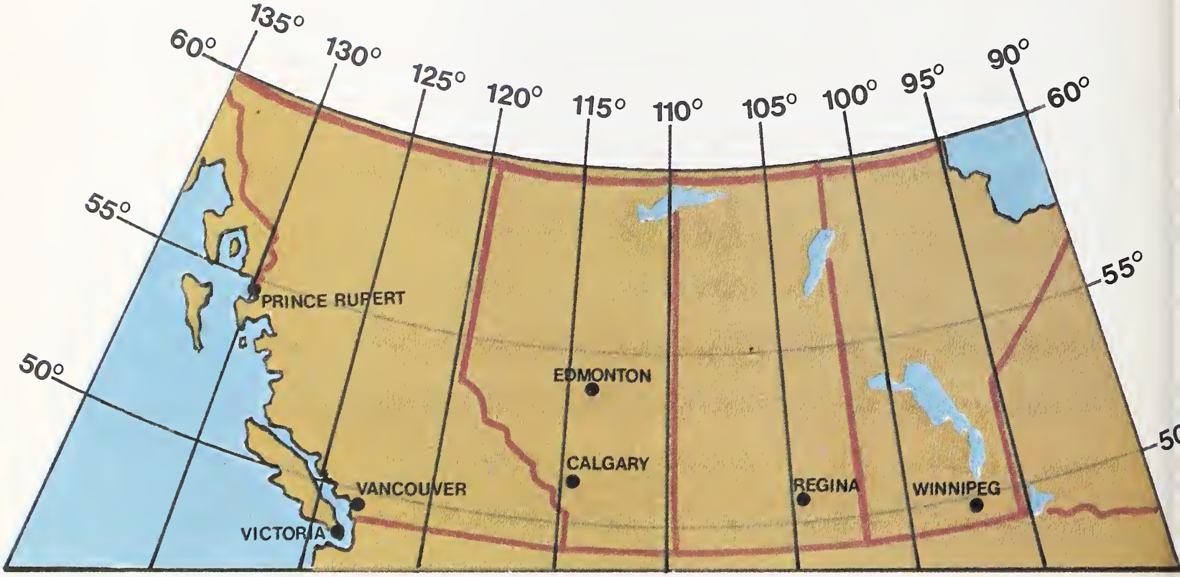
Suggested research: After the pupils have read the material provided above, you may wish to have them find out about two additional terms that are often used by some people who use maps. For the pupils to do this, have them look in reference books under the headings *latitude* and *longitude*. (Sample findings: Latitude refers to degrees north or south of the equator, and longitude refers to degrees east or west of the prime meridian.)

Suppose some people tell you they live in a large city that is near 50°N. By using the map below, would you be able to find which city they live in? Why or why not? [1]

Now suppose these people tell you that they live in a large city that is near 50°N and 105°W. Would you be able to find which city they live in? Why or why not? [2]

[1] **Sample answers:** No. Because there are several cities near 50°N.

[2] **Sample answers:** Yes. Because Regina is the large city which is closest to 50°N. and 105°W.



A Second Look

1. What are some things which make up the language of maps?
2. What is a grid, and how is it useful in reading maps?
3. What is a parallel? What is a meridian?
4. Why are most maps drawn to scale?

Suggested activity: After the pupils have read the two paragraphs above, you might use the map to have the pupils practice finding other cities. For the pupils to do this, you might ask them the following questions: What city is near 50°N. and 123°W.? What city is near 55°N. and 130°W.? (Sample answers: Vancouver; Prince Rupert.

Sample answers for "A Second Look": 1. Symbols, colours, scales, and grids are some of the things which make up the language of maps. 2. A grid is a network of equally-spaced lines, some of which run north and south on a map and some of which run east and west. A grid is useful in reading a map because the lines can be used to give reference points on a map. 3. A parallel is a reference line that runs east and west on a map. A meridian is a reference line that runs north and south on a map. 4. Most maps are drawn to scale so large areas that might cover the thousands of square kilometres on the surface of the earth can be

3 Using maps

Suppose you agreed to sell fifty tickets at school for a school play, but you have sold only two tickets in two weeks. And suppose you have only three days left to sell the rest of the tickets. One thing you might do to help yourself would be to make a map of your school. You might write down certain things on your map. You might write down how many people enter the school and leave the school through certain doors. You might also write down how many people pass by other places in the school during the day. Might using this information on your map improve your chances of selling tickets? Why or why not?[1]

Just as a map could be used to help sell tickets for a school play, maps can be used to help do other things.

[1] **Sample answers:** Yes. Because this information would point out the places where the most people pass during the day and, therefore, where I should stand to have the best chance to sell the most tickets.

Main concept of the chapter (pages 257–277): People often use maps to help them travel; study migration routes; find minerals; find oil, coal, and natural gas; find out about the weather; control infectious diseases; and plan cities.

Performance objective: After studying the information provided in this chapter, the pupils should be able to

—list at least five ways in which people use maps.

Important words: migrating, minerals, infectious diseases, city planning, population maps, land maps.

To study migration routes

Have you ever seen large numbers of birds flying south in the fall and flying north in the spring? If so, then you have seen birds *migrating* [MY-GRAYT-ihng], or moving from one area to another during a year. Many birds migrate. One reason they do this is so they can find food. Why else do you think many birds migrate?[1]

A few years ago, some people began to make maps of the migration routes of birds. These maps traced the routes that birds flew. These maps also pointed out certain places where birds stopped along the way. When people explored these places, they discovered that some of these places were being changed. That is, highways and cities were being built in these places. Do you think that such changes would cause the birds to change their migration routes? Why or why not?[2]

Many people are now interested in protecting these migratory birds. Might the information given on these maps help people to do this? If so, how?[3]

[1] **Sample answer:** So they can be in a climate most suitable to them.

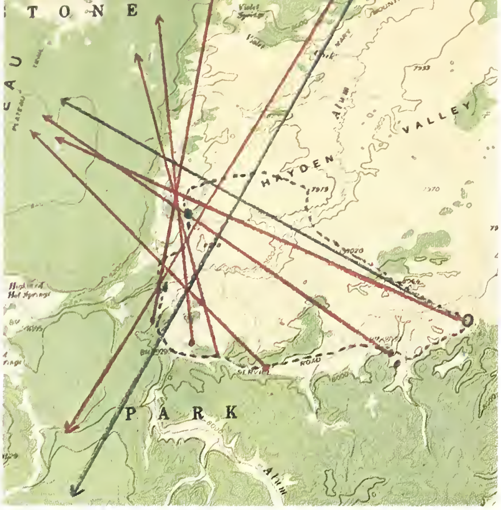
[2] **Sample answers:** Yes. Because the birds would no longer be able to find the food they need in these places.

[3] **Sample answers:** Yes. People could use this information to plan highways and cities in areas that are less likely to disturb these migration routes. Or people could use this information to plan for bird sanctuaries or preserves within the area these people plan to develop.

For You to Think About

There are many other animals which migrate. Some ocean fish migrate. How might knowing the migration routes of such fish be helpful to people?

Sample answer for "For You to Think About": It could help people who fish for a living know when and where to find the most fish.



The picture on the left shows a man placing a radio transmitter around the neck of an elk. Once the elk is released, radio signals enable people to trace its movements and map its migration route. The picture above shows a map made in this way.

Suggested discussion: After the pupils have looked at the pictures above and read the caption, you might ask them the following question: Why might people want to trace the movements and map the migration routes of animals such as the elk? (Sample answer: So people can keep from interfering with the natural environment of such animals, if at all possible.)

To help find minerals

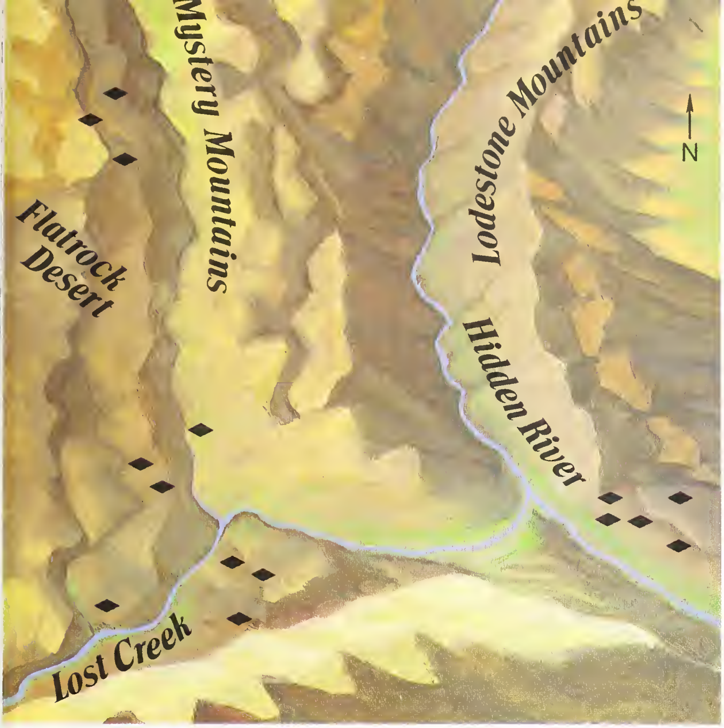
You probably know that many of the things you use every day, such as glasses and dishes, are made from minerals. Because minerals are used to make so many things, people must keep looking for new deposits of minerals.

Years ago, people discovered that certain minerals are usually found within certain kinds of rocks or rock layers. For example, people know that the mineral commonly called salt is found in areas that at one time were covered with ocean water. People also know that salt deposits are usually buried within certain kinds of rock layers. By mapping and studying the land, people are able to find the areas where salt deposits are most likely to be found. In what ways is salt important to people?[1]

[1] **Sample answer:** Salt is needed by the body to work properly. Salt is used to make some food taste better. Salt is used to soften water.

Deposits of the mineral uranium are often found by using a Geiger counter, such as the one shown on the right. What are some uses of uranium you know of?

Sample answer for the caption: Uranium is used to make electricity and to power some ships.



◆ Areas Containing Uranium

As deposits of uranium are discovered, they are marked on maps such as the one on the left. How might this map be helpful to people who mine uranium?

There is another way in which maps are used to help find mineral deposits. Some minerals are attracted to a magnet.

People have learned that they can find deposits of certain magnetic minerals by using a very powerful magnetic needle. They do this by mapping the movements of this needle as it is moved across land surfaces. When the needle makes a strong downward movement, it is most likely pointing out a deposit of a magnetic mineral. Many deposits of ore which contain the mineral iron can be found in this way. People make many things from iron. What might some of these things be?[1]

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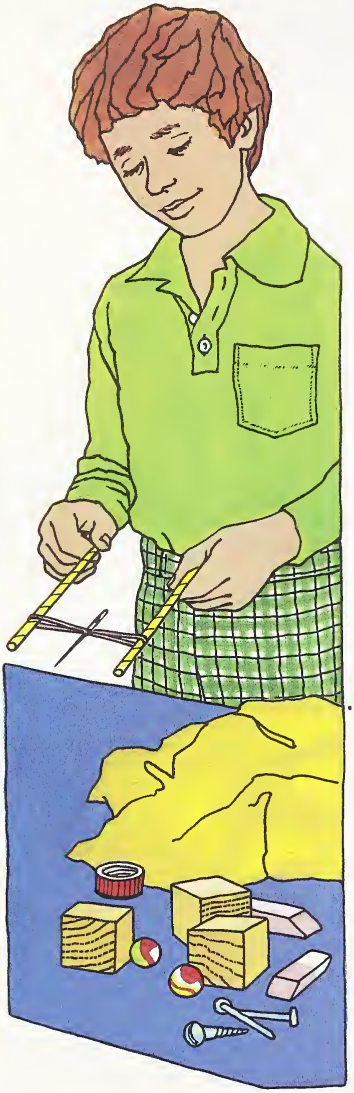
[1] **Sample answer:** Bridges, ships, parts of buildings.

Sample answer for the caption: It would help these people know where the larger deposits of uranium are and, therefore, where these people might want to begin mining.



FINDING OUT

How can you use a needle to find "deposits" of magnetic minerals?

You will need: 2 soda straws, thin rubber band, glue, bar magnet, needle, piece of cloth about 1 metre (3 feet) square, small metallic objects such as paper clips and nails, small nonmetallic objects such as wood blocks and pencil erasers.

- Rub the needle across one end of the magnet about 35 times. Be sure to rub in only one direction.
- Check to see if your needle is now a magnet by seeing if it will pick up a paper clip. If the needle will not, rub it across the end of the magnet a few more times.
- Glue your magnetized needle to the middle of the rubber band as shown. Glue the rubber band to the soda straws as shown.
- Place the objects on a wood table. Place some of them in a pile. Place others by themselves.
- Cover the objects with the cloth.
- Have someone who did not see where you put the objects move the magnetic needle across the top of the cloth. Watch the needle carefully.

Did your partner find any "deposits" of magnetic minerals? If so, what did the needle do to tell you this?

- Have your partner rearrange the "deposits." Do not watch as this is done. Try finding the "deposits" by using the magnetic needle.

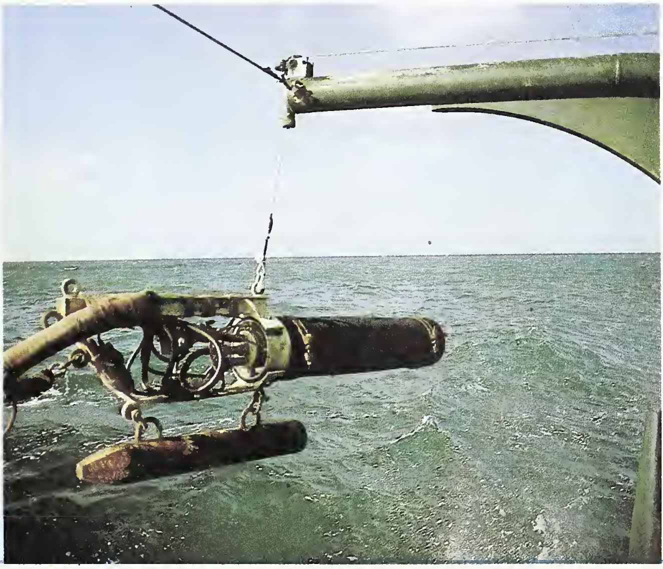
How would the movements of the needle be helpful in making a map of the "deposits"? Try making such a map.

Teaching helps for "Finding Out":
Processes used: observing, communicating, predicting.
Sample findings: The pupils will most likely state that their partner found deposits of magnetic minerals by watching the movements of the needle. Whenever the needle dipped down, it was pointing out such a deposit. The pupils may predict that they can make a map of the deposits by first drawing the boundaries of the area of "land" on a piece of paper. Then the pupils could move the needle across the land until the needle dipped. When this happened, they could measure the distance from a side boundary and from the top or the bottom boundary and plot the location of the deposit on their map.
Additional information: If the needle does not dip while passing over the deposits, the pupils might either make the needle a stronger magnet or increase the size of the deposits.

To help find oil, coal, and natural gas

Just as people use information on maps to help them find where mineral deposits might be, people also use information on maps to help them find certain other things. Such things include oil, coal, and natural gas.

When lowered from a ship into the water, the device (bottom left) is used to help map rock layers under the ocean. The map below shows such rock layers which may contain oil. Once oil has been found, offshore wells are set up to take the oil out of the earth.



You probably know that oil, coal, and natural gas are important to people. One reason they are important is because they are sources of energy. For example, oil, coal, and natural gas are used to make electricity. Oil and natural gas are also used to heat many homes.

Another reason oil, coal, and natural gas are important is because they are used in the making of many products people use. For example, plastics are made from oil and certain other things. Most gasoline is made from oil. But some gasoline is made from natural gas. Paints and detergents are made from coal and certain other things. Because oil, coal, and natural gas are used for so many things, people are mapping many new areas to help them find new deposits of these things. What are some other things you know of that are made from oil, coal, or natural gas? [1]

[1] **Sample answer:** Fertilizers, dyes, perfumes, nylon, rayon.

When deposits of coal are found directly under the surface of the earth, they are usually removed by strip-mining, as is shown in the picture. After the coal is removed, the land is often filled in and replanted with grass and trees. Why do you think this is done?

Sample answer for the caption: So the soil will not be carried away by wind or by rushing water.

To find out about the weather

Have you ever planned a picnic or a hike and then not been able to go because of rain? Most people have had this happen to them at some time. Because of this, people often use information on weather maps to help them make such plans.

Weather maps are often found in newspapers. What kinds of information might such a map have? How might this information be helpful to farmers? Truck drivers?[1] What other people might find this information helpful? Why?[2]

[1] **Sample answers:** What the weather will most likely be like on a certain day and what the weather may be like during the next week or month. Farmers might use this information to help them decide when to plant crops. Truck drivers might use this information to help them plan the routes they will take.

[2] **Sample answers:** Airplane pilots would find the information helpful because they could use it to plan their route. Anyone who travels could use the information to help them plan their route.

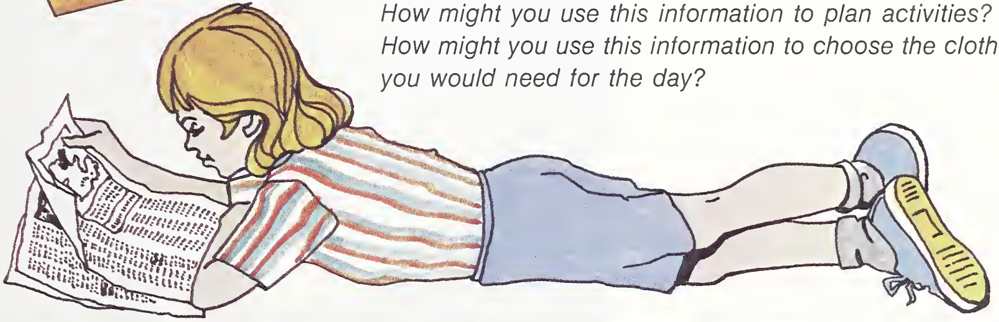
FINDING OUT

What are some things you can learn from a newspaper weather map?

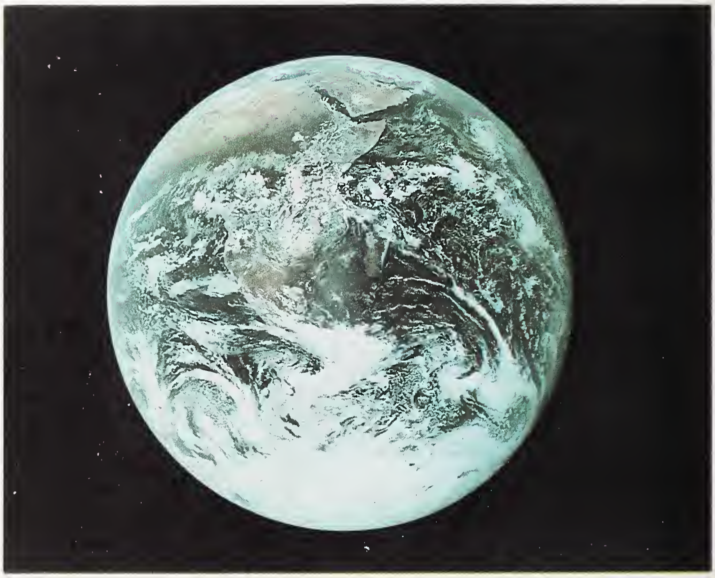
You will need: newspaper

- Find a weather map in your newspaper.
- Look at the symbols used on this map.

What kinds of information does the map give you?
How might you use this information to plan activities?
How might you use this information to choose the clothing you would need for the day?

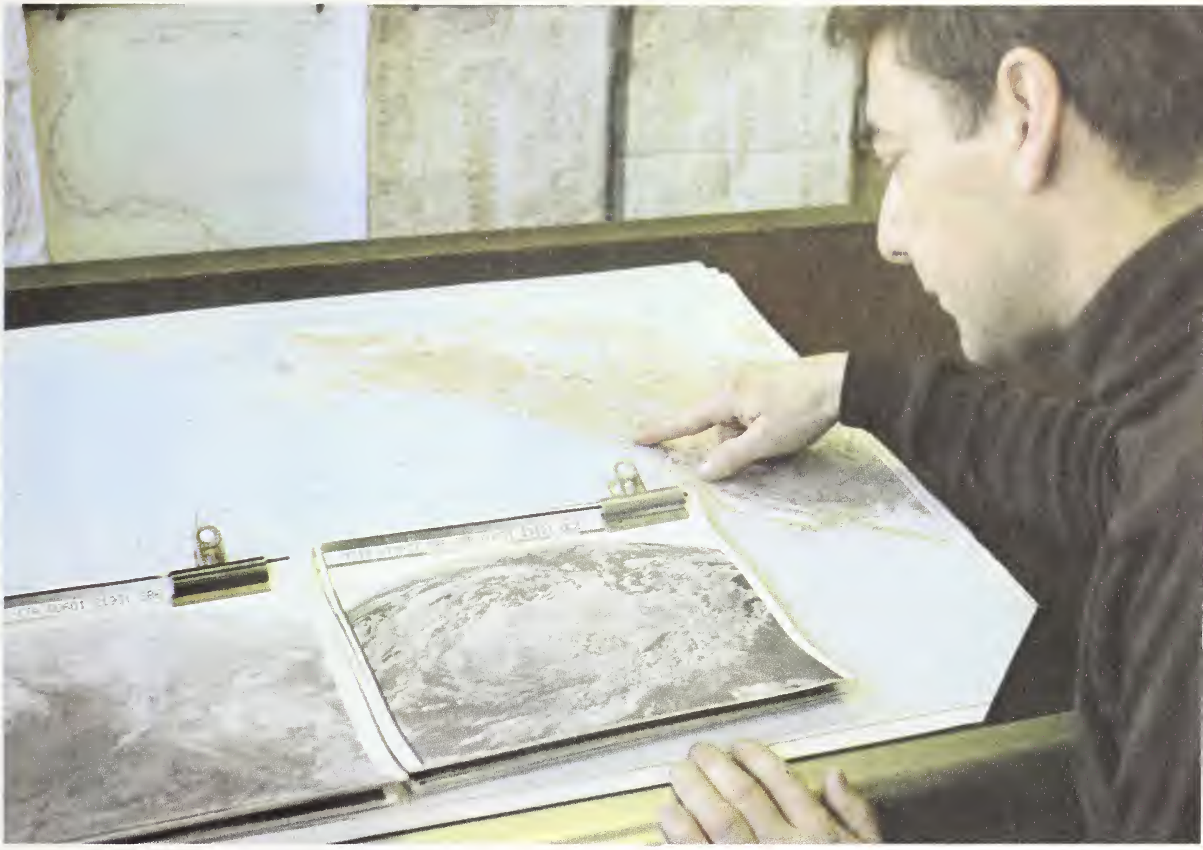


Teaching helps for "Finding Out":
Processes used: observing, communicating, interpreting data.
Sample findings: The pupils may observe that a weather map might provide them with information such as the approximate high and low temperature for the day, the probability of rain or snow, the probability of sunshine or cloudiness, and what the weather may be like for the next day or two. The pupils will most likely state that they could use this information to help them know when to plan outdoor or indoor activities. The pupils might also state that they could use this information to know when they will need to wear warm or cool clothing.



Much weather information is collected by weather satellites, such as the one shown at the top. The picture of the earth at the right was taken from a weather satellite. How do you think such a picture helps weather forecasters make better weather predictions than ever before?

Sample answer for the caption: Such a picture helps weather forecasters because they are able to see large areas of the earth and, therefore, they can track the movements of the weather more accurately than ever before as it travels from one area to another.



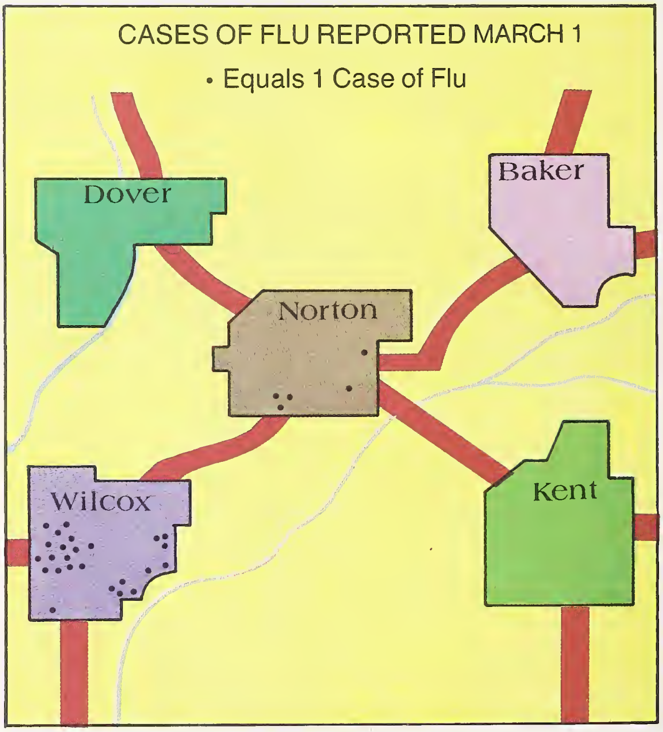
To help control infectious diseases

Have you ever had a shot, or injection, to protect you against mumps? Against measles? Mumps and measles are examples of *infectious* [ihn-FEHK-shuhs] *diseases.* Infectious diseases are those kinds of diseases that spread from one person to another. What are some other infectious diseases you know of?[1]

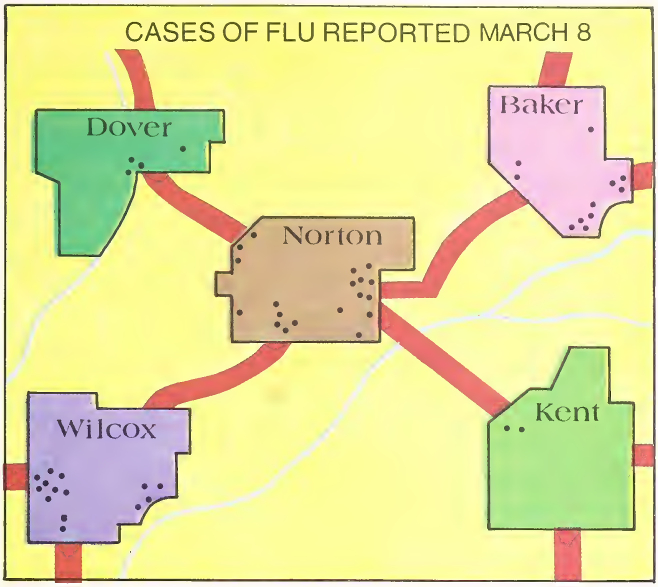
[1] **Sample answer:** Flu, chicken pox, colds.

In addition to other uses of maps, they are sometimes useful to people in controlling infectious diseases. For example, maps are often used to show how many people in an area have a certain infectious disease. By comparing this information on an up-to-date map with such information on an older map, people can decide whether an infectious disease is spreading or not. Comparing the information on such maps can also show where such a disease might be spreading. Do you think that having this kind of information would help people control the spread of infectious diseases? Why or why not? [1]

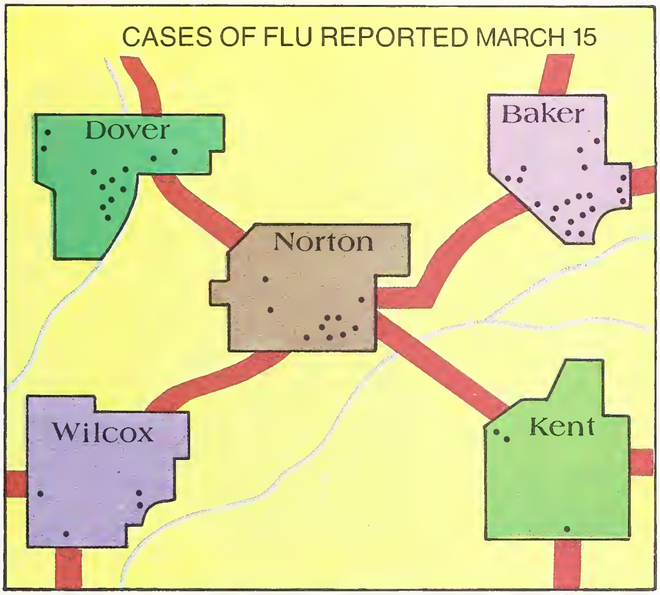
[1] **Sample answers:** Yes. Knowing that a certain infectious disease, such as the flu, is spreading can be helpful because the people who do not have the disease can sometimes get an injection that will protect them from getting the disease.



Suggested discussion: After the pupils have discussed their answers to the questions in the caption on page 269, you might have them try to interpret some of the information provided on the map above and the maps on page 269. For the pupils to do this, you might ask them the following questions: Which city has had the fewest cases of flu for this three-week period? (Sample answer: Kent.) For what reasons do you think this city has had the fewest cases of flu for this three-week period? (Sample answer: Most of the people in Kent have had their flu shots. Few people have traveled from Kent to the other cities or from the other cities to Kent. The flu is just beginning to spread to Kent.)



• Equals 1 Case of Flu



Look at the maps on pages 268 and 269. How many cases of flu were reported in each city during the week of March 1? March 8? March 15? In what areas has the flu spread during this three-week period? How might this information be helpful to people?

Sample answers for the caption: During the week of March 1, there were 25 cases in Wilcox, 5 cases in Norton, and no cases in Dover, Baker, and Kent. During the week of March 8, there were 14 cases in Wilcox, 19 cases in Norton, 4 cases in Dover, 11 cases in Baker, and 2 cases in Kent. During the week of March 15, there were 4 cases in Wilcox, 10 cases in Norton, 12 cases in Dover, 20 cases in Baker, and 3 cases in Kent. The flu has spread from Wilcox to all the surrounding cities. This information might be helpful to people in cities nearby who have not got the flu yet. This information could be helpful because these people might have time to get flu shots that would help protect them against the flu.

To help plan cities

You probably know that the population is growing larger and larger. And as this happens, more land is being used for housing and for industry. Because of this growth, people are trying to plan their cities carefully. One reason is so that the needs of a growing population can be met. These needs include things such as enough water and enough homes for people. What might some other needs be? [1]

Another reason for careful city planning is so that the natural environment can be preserved as much as possible. Why do you think this is important? [2]

[1] **Sample answer:** Schools, recreational areas, stores.

[2] **Sample answer:** So people will always have enough land for growing food and for recreation. Also, so animals will always have enough land to survive.

Population maps. One kind of map that is helpful in planning cities is a population map. A population map can give many different kinds of information. For example, a population map may show how many people live in a city. It may also show areas within a city where a great number of people live and areas where a small number of people live. This kind of information can help people decide where new housing might be built. In this way, people can help keep areas within cities from becoming overcrowded. Why might this be important to people?[1]

A population map can also show if the number of people within a city is growing larger. This information can help people decide if more homes will be needed in the future. Such information can also help people decide on other things that might be needed in the future. These things might include more public transportation and more recreational areas. What might some other things be?[2]

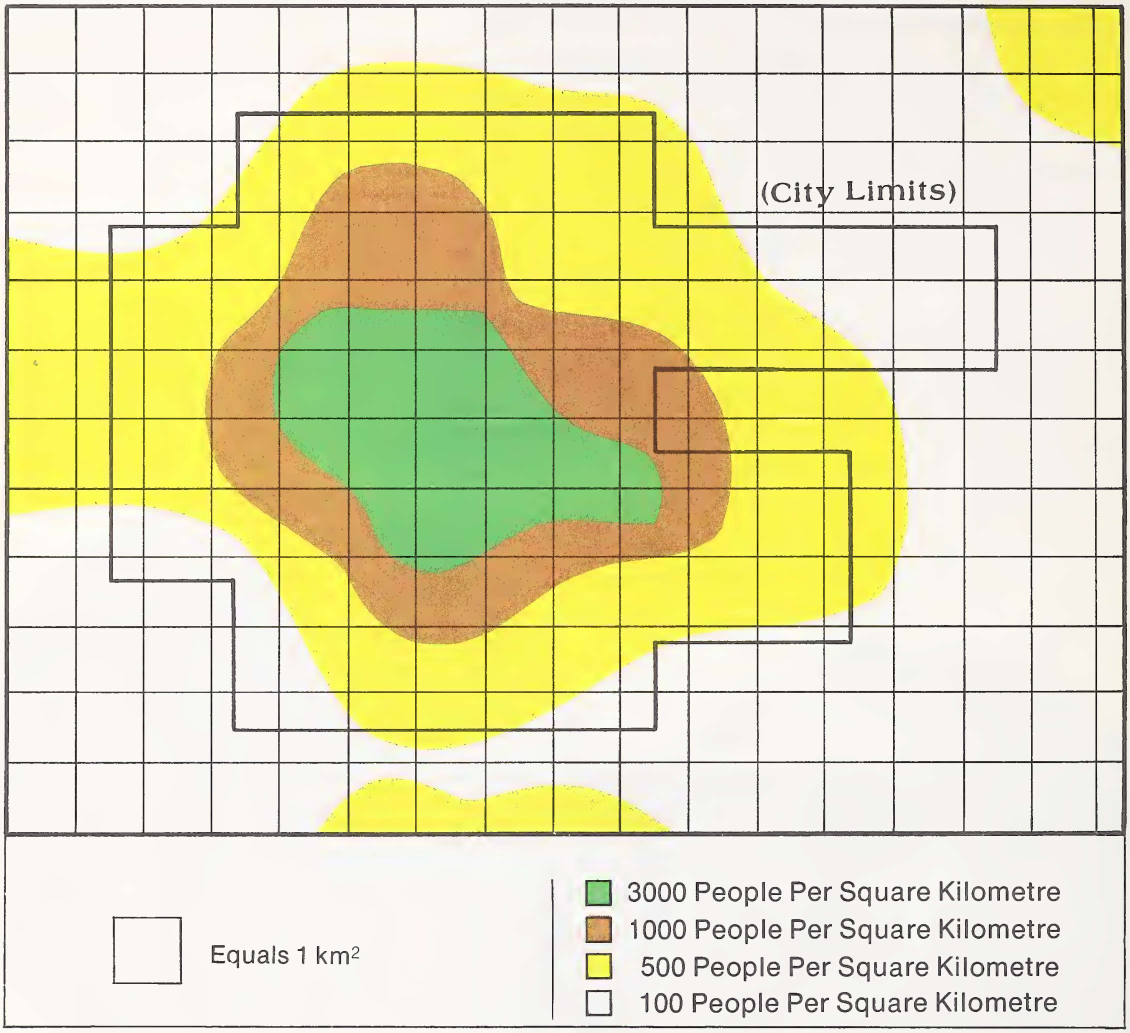
[1] **Sample answer:** Because when an area becomes overcrowded, it becomes more difficult for people to get from one place to another and for people to get many of the products they need to buy.

[2] **Sample answer:** Schools, shopping centers.

The people in this picture are city planners. How might using maps and a scale model of a city be helpful to these people in planning cities?

Sample answer for the caption: City planners can use maps and scale models to help them plan cities in such a way that the needs of the population are met and the natural environment is preserved as much as possible.

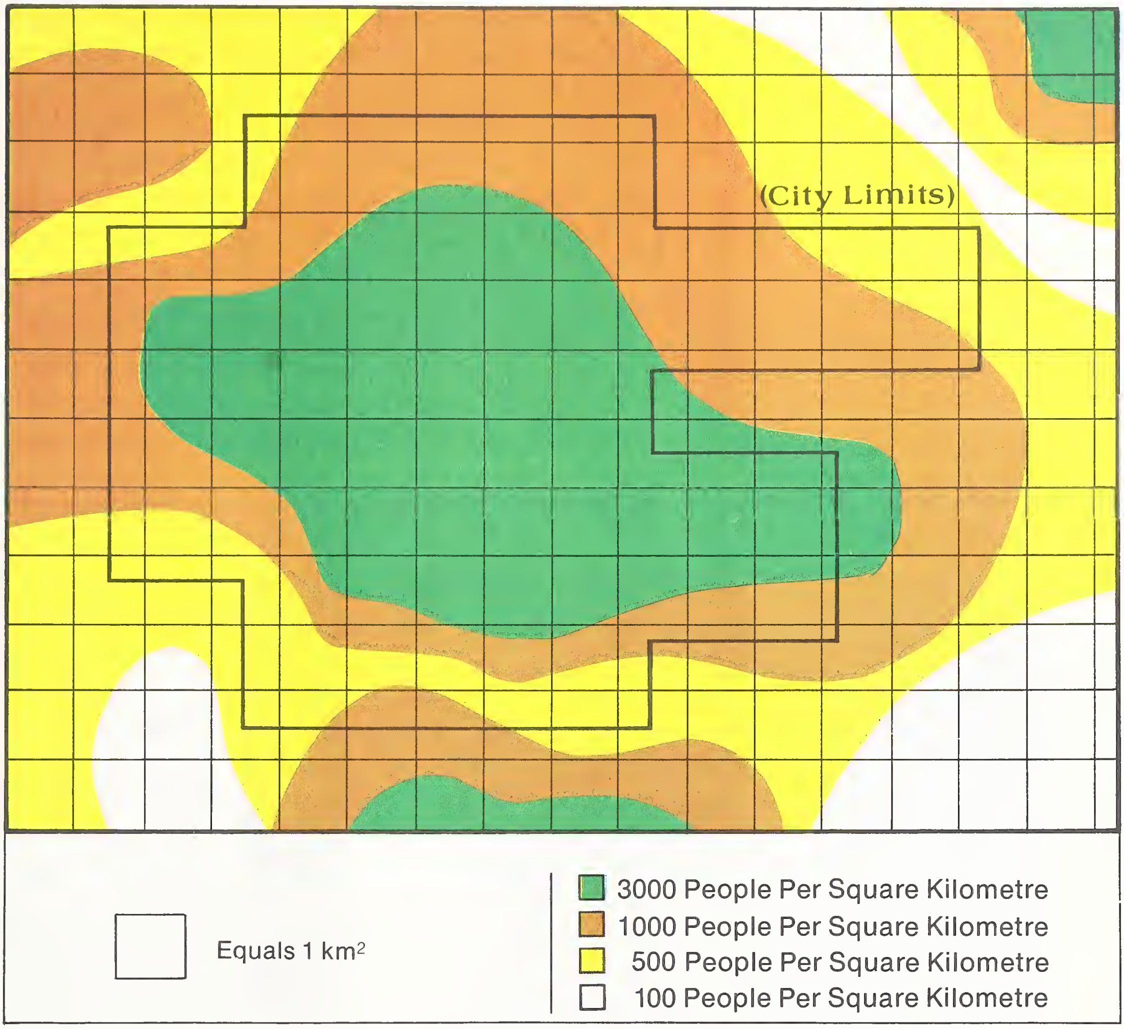
POPULATION MAP OF SPRINGER (1965)


(City Limits)
Equals 1 km²
🟩 3000 People Per Square Kilometre
🟫 1000 People Per Square Kilometre
🟨 500 People Per Square Kilometre
☐ 100 People Per Square Kilometre

Shown above is a 1965 population map of the city of Springer. About how many square kilometres does Springer cover? Where do most of the people live in Springer?

Sample answers for the caption: Springer covers approximately 84 km². Most of the people live in the centre of Springer.

CURRENT POPULATION MAP OF SPRINGER


(City Limits)
Equals 1 km²
🟩 3000 People Per Square Kilometre
🟧 1000 People Per Square Kilometre
🟨 500 People Per Square Kilometre
☐ 100 People Per Square Kilometre

Above is a current population map of Springer. Compare this map with the map on page 272. In what ways has the population of Springer changed? How might this information be helpful to the city planners of Springer?

Sample answers for the caption: The population has grown, and it has moved outside the city limits in some places. This information might help the city planners decide where new housing will need to be built and where more public transportation will need to be provided. Also, the city planners might use this information to decide if a larger water supply will be needed in the future.

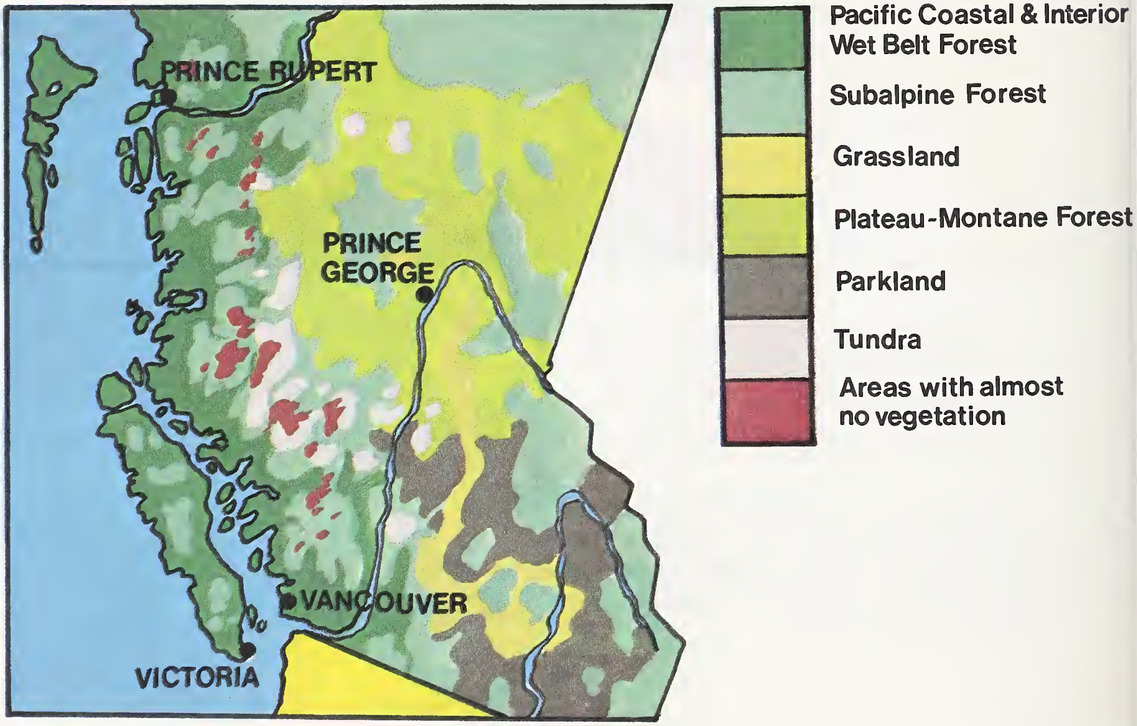
Land maps. There is another kind of map which people can use to help plan the growth of cities. This kind of map shows what the land is like around a city. For example, this map might show lakes and rivers in the area. By having this information, people could decide where they might build a new water-treatment plant. This information could also help them decide where they might build a dam. The dam could be used to supply waterpower for making electricity. Why might these things be important to a growing population?[1]

In what other ways might a land map be helpful in planning cities?[2]

[1] **Sample answer:** Because as a population grows larger, more fresh water and electricity are needed.

[2] **Sample answer:** It might help people choose the best land for industries to be built on. It might help people decide which land would be best developed as a recreational area.

What things on this land map might be important to know about in planning cities in this area?



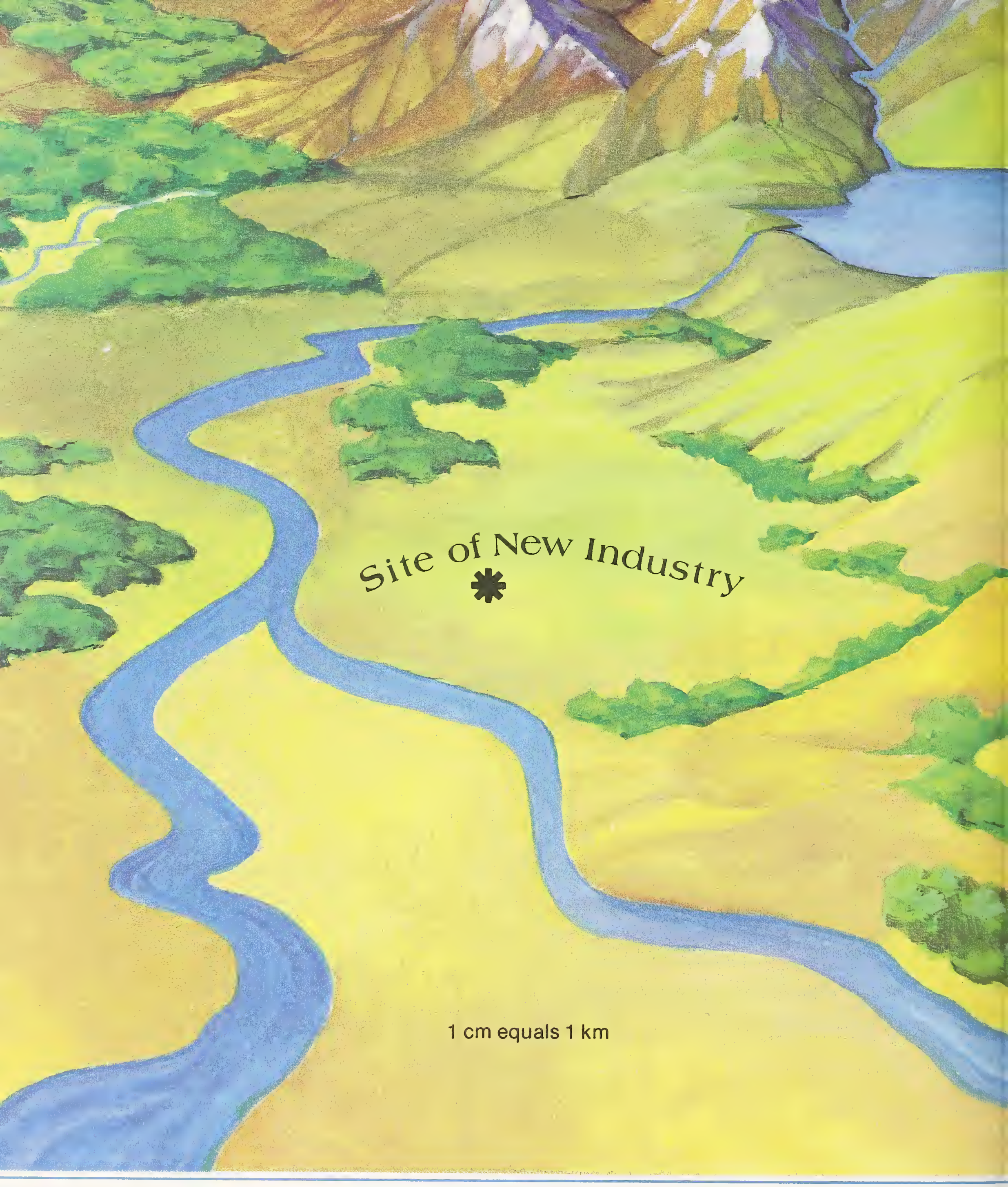
Sample answer for the caption: Where a water supply might be found and where highways and railroads might be built most easily.

Planning your own city. How would you like a chance to plan your own city? The picture on pages 276–277 shows an area of land on which a new industry will be built. This industry will provide jobs for one thousand new people. See if you can plan a new city for these people and their families. In order to help you plan your city, write out your answers to the following questions on a piece of paper:

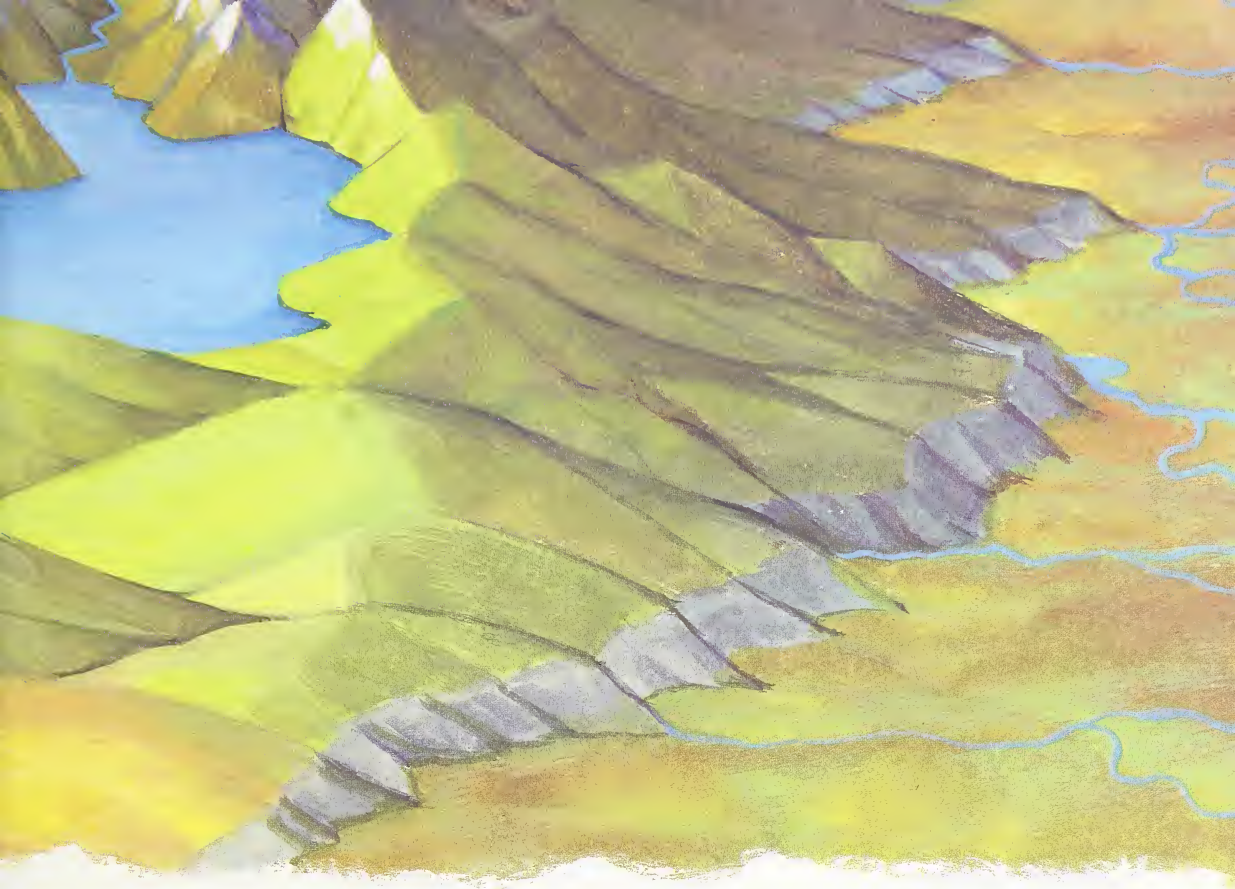
Where would you have new housing built? Why?
What kinds of housing would you provide? Why?
Where would you get the water for the city?
Where would you build a water-treatment plant?
Where would you build a sewage treatment plant?
Would you provide some public transportation? If so, what kinds?
Would you provide recreational areas? If so, what kinds? Where would you have them built? Why?
Where would you have schools built? Why?
What kinds of stores would you provide?
Where would you have these stores built? Why?
What other things would you need to have built for these people? Where would you have each of these things built? Why?
What things would you do to make sure the natural environment is preserved as much as possible?

Compare your plan with the plans made by your classmates. What things did you include that they did not? What things did your classmates include that you did not? You might want to get together with your classmates and make a map of your city using all the information you have collected!

Suggested research: Before the pupils begin the activity suggested above, you might wish to have them find out more about city planning. For the pupils to do this, you might have them look in reference books under the heading *city planning.*



Suggested activity and discussion: After the pupils have completed the activity suggested under "Planning your own city," you might have them invite a city planner to the class to look at their planned city and to discuss city planning.



A Second Look

1. What kinds of information might a map of bird-migration routes show?
2. How are maps used to help find mineral deposits?
3. Why are oil, coal, and natural gas important to people?
4. How can maps be used to help plan cities?
5. What are some other uses of maps?

Sample answers for "A Second Look": 1. A map of a bird-migration route would show the route certain birds take as they move from one area to another during a year. Such a map would also point out certain places where the birds stop along the way. 2. Maps of rocks and rock layers often point out places where certain minerals may most likely be found. 3. Oil, coal, and natural gas are important to people because these things are sources of energy and because they are used in the making of many products people use. 4. Maps can be used to help plan cities because maps can point out how many people live in a city, where the most people live within a city, and what the land is like around a city. 5. Maps can also be used to find out about the weather and to help control infectious diseases.

Workers Who Use Science

There are many things which are needed to make maps. One thing is the exact measurement of parts of the earth. People who measure parts of the earth are called *surveyors* [sur-VAY-urz].

There are many different kinds of surveyors. One kind of surveyor measures the boundaries of property, such as the lot on which a house is built. A map which shows boundaries is important to people when buying and selling property. It is important because these measurements are accepted as the correct boundaries of property.

Another kind of surveyor measures and maps bodies of water, such as harbours and rivers. This kind of surveyor not only measures the land around bodies of water, but also measures water depth and currents. A map with this kind of information is helpful to people when building things such as dams, piers, and bridges.

To find out more about the work of surveyors, try finding the answers to these questions:

What do highway surveyors do, and how is their work helpful to people?[1]

What do pipeline surveyors do, and how is their work helpful to people?[2]

What do mining surveyors do, and how is their work helpful to people?[3]

What are some of the tools that surveyors use?[4]

Along with using sources of your own, you may find it helpful to write to the following source: Canadian Institute of Surveying, Box 5378, Station F, Ottawa, Ontario K2C 3J1.

Sample answers for "Workers Who Use Science":

[1] Highway surveyors make exact measurements of certain areas where new highways are planned. These highways will then make traveling much easier for people.

[2] Pipeline surveyors make exact measurements of areas where pipelines may be built so supplies of things, such as oil and natural gas, can reach people more quickly.

[3] Mining surveyors map areas thought to contain large deposits of minerals so the minerals can be mined and used to make products for people.

[4] Some of the tools surveyors use are maps and a transit (shown above).

Reviewing the Main Ideas

There are many different kinds of maps.

There are many things which make up the language of maps. Some of these things are symbols, colours, scales, and grids.

Symbols are used on maps to represent certain things.

Colours are used on maps to point out such things as countries, provinces, counties, or land elevation.

Most maps are drawn to scale.

Grids are used on maps so that people can find places on these maps more easily.

People often use maps to help them travel; study migration routes; find minerals; find oil, coal, and natural gas; find out about the weather; control infectious diseases; and plan cities.

Reading About Science

Childcraft—The How and Why Library, Volume 4. *World and Space*. Don Mills, Ontario: Addison-Wesley (Canada) Ltd., 1974.

Hackler, David. *How Charts and Drawings Help Us.* Stratford, Ontario: Scholar's Choice Ltd., 1965.

———— *How Maps and Globes Help Us.* Stratford, Ontario: Scholar's Choice Ltd., 1970.

Tannenbaum, Beulah, and Stillman, Myra. *Understanding Maps.* Scarborough, Ontario: McGraw-Hill Ryerson Limited, 1969.

Reviewing the unit: You may wish to have the pupils study "Reviewing the Main Ideas" to help prepare for "Testing for Understanding" found on page 280.

For further reading: You may wish to encourage the pupils to read the books listed under "Reading About Science" and other books and articles related to mapping. Such articles may be found in reference books under the headings *maps*, *weather*, *longitude*, and *latitude*.

Testing for Understanding

Ideas to Check

On your paper write *T* for each sentence below that is true. Write *F* for each sentence that is false.

T 1. Besides using maps to plan and take trips, people use maps for other reasons.

F 2. All symbols used on maps look like the things they represent.

T 3. A grid on a map is made up of lines that run north and south and lines that run east and west.

T 4. Mapping and studying rock layers can be helpful in finding certain minerals.

T 5. Most maps are drawn to scale so that large areas of land can be shown on a map.

T 6. Population maps are helpful to people who plan cities.

Words to Use

Write on your paper the word or words that best fit in each blank below. Choose from these words: *symbols, legend, scale, grid, reference point, degrees, equator, magnetic, prime meridian.*

1. You can find out what a symbol represents by looking at the ____ on a map.
2. If you tell someone that a city can be found on a map where two certain lines cross, you are giving that person a ____ for finding the city.
3. People can sometimes find deposits of certain minerals by using a ____ needle.
4. The ____ and the ____ are marked by degrees.

legend

reference point

magnetic

equator; prime meridian

Suggestions for evaluation: You may wish to use the test questions provided under "Testing for Understanding" to evaluate the pupils' understanding of the main ideas and important words of this unit. Additional test questions for the unit "Mapping the Earth" are provided for you on page T21 of the Teacher's Manual. These test questions may be duplicated for classroom use. Answers to these additional test questions can be found on page T22 of the Teacher's Manual.

Having Fun with Science

Brainteasers

1. A large ship was sailing across the ocean. There was a woman standing at the front of the ship, and another woman standing at the rear of the ship. It was Tuesday for the woman standing at the front of the ship, but Wednesday for the woman standing at the rear of the ship. How could this be so?

2. A man lived in a house that had all four sides facing south. One day the man saw a bear walk by his window. What colour was the bear? Explain your answer.

Looking at Some Early Maps

Look for some maps made by early explorers. Encyclopedias may have such maps. Trace the routes taken by these explorers. Do you suppose that people might follow these same routes if they were just beginning to explore the world today? Why or why not? In what ways are these maps different from present-day maps? Are they alike in any ways? If so, how?

Mapping Your Own Exploration!

Some people, such as hikers, travel by using a compass as well as a map. A compass has a magnetic needle on it which shows directions such as north and south. Get a pencil, some paper, and a compass. Go for a short hike, such as through a city park. On your paper, make a map of the path you walk by using information from your compass. Give your map and compass to someone else. See if that person can take the same hike you did by using your map and compass. Why is it important for people to make maps that others can easily follow?

For further involvement: You may wish to use "Having Fun with Science" to involve the pupils in fun activities which reinforce some of the main concepts of the unit "Mapping the Earth." You may also wish to encourage the pupils to make up additional activities related to mapping.

Sample answers for "Brainteasers": 1. The ship was sailing across the International Date Line. 2. The bear was white. The only place a house that had all four sides facing south could be would be at the North Pole. Therefore, the bear was a polar bear.

Glossary-Index

One of the purposes of this glossary-index is to help you pronounce and understand certain words in this book. Another purpose is to help you find out about topics in this book that may interest you. You can find out about a topic by turning to the page or pages given at the end of each topic that is listed.

In this glossary-index, the syllables of a word are separated by a space. This can help you say the word. A special spelling may follow a word. This spelling always appears in [ ]. This spelling can also help you say the word. When a word has two or more syllables, one syllable is stressed more than others. This syllable is always spelled with large capital letters, as in the word *gravity* [GRAV-uht-ee]. Syllables that are not stressed are always spelled with small letters. Sometimes a word has one or more syllables that are stressed, but not so much as the syllable spelled with large capital letters. Those syllables are spelled with small capital letters, as in the word *electricity* [ih-LEHK-TRIHS-uht-ee]. Words of only one syllable are also spelled with small capital letters, as in the word *nerve* [NURV].

Sometimes a syllable in a special spelling is placed inside ( ), as in the word *mineral* [MIHN(-uh)-ruhl]. This means that some people say the syllable when they say the word, but some people do not.

Below is a list of the letters and letter groups used for the special spellings. Across from each letter or letter group, you can read how most people say the letter or letter group.

Letter or letter group	Say like
a	*a* in *hat* [HAT]
ah	*a* in *father* [FAHTH-ur]
aw	*a* in *all* [AWL]
ay	*a* in *face* [FAYS]
ch	*ch* in *child* [CHYLD] and in *much* [MUHCH]
ee	*e* in *equal* [EE-kwuhl]
eh	*e* in *let* [LEHT]
eye	the first *i* in *iris* [EYE-ruhs]
g	*g* in *go* [GOH]
ih	*i* in *hit* [HIHT]
o	*o* in *hot* [HOT]
oh	*o* in *open* [OH-puhn]
oo	*oo* in *food* [FOOD] and *u* in *rule* [ROOL]
ow	*ou* in *out* [OWT]
oy	*oi* in *voice* [VOYS]
s	*s* in *say* [SAY]
sh	*sh* in *she* [SHEE]
u	*u* in *put* [PUT] and *oo* in *foot* [FUT]
uh	*u* in *cup* [KUHP]
ur	*er* in *term* [TURM] and *ir* in *sir* [SUR]
y	*i* in *nice* [NYS]
z	*s* in *degrees* [dih-GREEZ]
zh	*s* in *treasure* [TREHZH-ur]

Ac ids: and dissolving rocks, 198–200; given off by plants, 200; in rain, 198; in soil, 227–229
Air: 64, 66; diaphragm and, 68; light and, 150; lungs and, 65; soil and, 221–222, 227; trachea and, 65
Al gae [AL-jee], 20–22
A moe ba [uh-MEE-buh], 16
An ti sep tic [ANT-uh-SEHP-tihk], 12–13
Ar ter ies: the blood vessels which carry blood away from the heart, 61–63

Bac te ria [bak-TIHR-ee-uh], 8–16
Bac te ri ol o gists [bak-TIHR-ee-OL-uh-juhsts], 44
Bases: in soil, 228–229
Bat tery: 102, 107–108, 110–111, 113, 116, 120, 122, 129–130 / in cars, 103; in flashlights, 103; in series, 109
Baux ite [BAWK-SYT], 208
Blood: 54; capillaries and, 63; and carbon dioxide, 66; heart and, 60; hookworms in, 33; job of, 59; lungs and, 60; and minerals, 82; and protein, 79; protozoans in, 19; vessels and, 61; and wastes, 74
Blood ves sels: organs which are a part of the circulatory system, 57, 61–64, 73–74
Bones, 53–55, 82, 212–213
Brain: and the eyes, 170, 172, 175, 183; nerve tissue in, 56; optical illusions and, 178; protection of, 53
Bread- ce re al group: one of the four basic food groups, 84–86
Breath ing, 64, 66–69

Cal ci um, 82
Cap il lar ies: the tiny blood vessels through which oxygen, food, and wastes pass easily, 63 / from the lungs, 65–66
Car bo hy drates [KAHR-boh-HY-DRAYTS]: a nutrient used by the body cells for energy, 78–79
Car bon di ox ide [KAHR-buhn dy-OK-SYD]: a waste gas given off by the cells of the body, 66, 70
Cells: tiny units of living matter, 51–52, 57, 70–71, 73 / of amoeba, 16; of bacteria, 9–10; and carbon dioxide, 66; chains of in algae, 21; of the eye, 170, 175; food and, 59; in mosses, 28; nutrients and, 76–79, 83; and oxygen, 66; of protozoans, 15–17; reproduction of, 10, 17; rest and, 88
Chlo ro phyll [KLOHR-uh-FIHL]: a green substance in most plants that helps them make their own food, 17, 21
Cir cuit [SUR-kuht]: a pathway along which electricity flows, 108, 115–118 / fuses and, 120–121; in parallel, 111–113; in series, 109–111
Cir cuit break ers, 122–123
Cir cu la to ry [SUR-kyuh-luh-TOHR-ee] **sys tem:** the system of the body made up of the heart, blood vessels, and blood, 57, 59, 61–63, 70
City plan ning, 270–271, 274–275
Col o ny [KOL-uh-nee]: a group of living things living together, 9 - 11, 21, 36 - 37
Col our: afterimage and, 174 - 175; in coloured light 166 - 167; importance of, 158; prisms and, 160; of the sky, 165; of the spectrum, 160 - 162, 164; use of on maps, 248 - 249; in white light, 159 - 163

Con duc tors [kuhn-DUHK-turz]: things through which electricity flows, 106–108
Con nec tive tis sue: one of the four main groups of tissues in the body, 53
Con serv ing [kuhn-SURV-ihng]: of fossil fuels, 235; of land, 231; of minerals, 234–235; of soil, 231–233

Core: the center of the earth, 203–204
Cor nea [KAWR-nee-uh], 169–170, 183
Crust: the layer of rock below the surface of the earth, 202, 204, 206, 214–216

De cay: to break down, 14, 222, 224
Di a phragm [DY-uh-FRAM], 65, 68–69
Di eti tians [DY-uh-TIHSH-uhnz], 92
Di ges tive [dy-JEHS-tihv] **sys tem:** the system in the body which breaks down food so it can be used by the cells of the body, 57, 70–74
Dis ease, 12, 19, 38, 42, 183
Dis solv ing [dihz-OLV-ihng], 198
Doc tor, 89, 91, 183–184
Drones [DROHNZ]: male bees, 36

Earth, 195–205
Elec tric mo tors, 101, 131–133
Elec tri cian, 140
Elec tric i ty [ih-LEHK-TRIHS-uht-ee]: from batteries, 102–103; control of, 114–123; current, 101–102, 108; helpfulness of, 126–138; how made, 235; kinds of, 98–138; measurement of, 124–125; power plants and, 103–105; static, 98–101. *See also* Battery; Conductors; Insulators.
Elec trons [ih-LEHK-TRAHNZ], 99
El e va tion [EHL-uh-VAY-shuhn], 249
En er gy, 77–79, 100, 102
En vi ron ment, 32, 270–277
Ep i the li al [EHP-uh-THEE-lee-uhl] **tissue:** one of the four main groups of tissue in the body, 54
Equa tor: the parallel marked 0° on a map, 254
Esoph a gus [ih-SOF-uh-guhs]: the tube that food passes through to get to the stomach, 71–72

Eu gle na [yu-GLEE-nuh], 17
Eyes: 57, 155; of animals, 185–187; care of, 184; of flies, 35; importance of, 168, 171–173; parts of, 169–170; problems with, 181–183

Far sight ed. *See* Eyes, problems with.
Fats: a nutrient used by the body cells for energy, 77–78
Fer til ize [FURT-uhl-YZ], 224
Food: 80–81; chains of, 14, 19, 22; in the circulatory system, 59, 61, 63; daily guide of, 85; in the digestive system, 70; at meals, 76; and minerals, 82–83; muscles and, 54; and soil, 219; and vitamins, 83. *See also* Four food groups.
Forces: things which can change the land, 196–205, 220
Fos sil fu els, 105, 235
Fos sils [FOS-uhlz], 213
Four food groups: foods grouped according to the nutrients they are mostly made up of, 84–85
Fun gi [FUHN-JY]: small plants without chlorophyll, 23–27
Fuses, 121–123

Gases. *See* Carbon dioxide; Nitrogen; Oxygen.
Ge ol o gists [jee-OL-uh-juhsts], 236
Glass es: things which can help correct some eye problems, 153, 182–183
Gneiss [NYS], 216
Gran ite [GRAN-uht], 214, 216
Grid: lines drawn on a map to help find places on the map, 252–253

Ha lite [HAL-YT]: salt, 208, 260
Heart: the part of the circulatory system which pumps blood to all parts of the

body, 57, 63, 68 / and blood vessels, 60–62; and checkup, 89; fats around, 77; as a kind of muscle, 54–55; protection of, 53; and vitamins, 83

Hu mus [HYOO-muhs]: the decaying parts of plants and animals in soil, 226–227

Ig ne ous [IHG-nee-uhs] **rock,** 214–216

Im age: 155; and the brain, 172; of the face, 156; farsightedness and, 182; and motion, 176–177; nearsightedness and, 182; on the retina, 170–171

In fec tious [ihn-FEHK-shuhs] **dis ease,** 267–269

In sects: 18; harmful, 19, 38–39, 42; helpful, 39; legs of, 34, 36; and spiders, 40, 42; where found, 38–39; wings of, 35–36

In su la tors [IHN(T)-suh-LAYT-urz]: things through which electricity does not flow, 108, 150

In ter na tion al Date Line, 255

Iron, 82

Kilo watt- hour, 124

Large in tes tine: an organ that is part of the digestive system, 72, 74

Leg end [LEHJ-uhnd]: a list of the symbols used on a map, 247

Lenses, 151–153, 170, 182–183

Light: bouncing, 154–157, 159, 163, 166; coloured, 166-167; and the eyes, 169-173, 182; passing through things, 149–153; sources of, 146; traveling, 147–148; white, 159–163, 166

Lime stone, 212–213, 216, 228

Liv er: an organ that is part of the digestive system, 57, 72–73, 77

Lungs: organs which are part of the respiratory system, 60, 69 / and air, 65, 67; blood from, 66; and checkup, 89; and diaphragm, 68

Mag ma [MAG-muh], 214–215

Mag net [MAG-nuht], 130–133

Ma lar ia [muh-LEHR-ee-uh], 19

Man tle: the layer of rock between the crust and the core of the earth, 203–204

Maps: 242; colours on, 248 — 249; grids on, 252–256; importance of, 243; kinds of, 243–245, 265–266, 270–274; scaling of, 250–251; symbols of, 246–247; uses of, 257–277

Meat group: one of the four basic food groups, 84–85, 87

Me rid i ans [muh-RIHD-ee-uhnz]: lines drawn north and south on a map, 254–255

Meta mor phic [MEHT-uh-MAWR-fihk] **rock,** 216

Mi cro scope [MY-kruh-SKOHP], 9, 16, 51

Mi grat ing [MY-GRAYT-ihng], 258

Milk group: one of the four basic food groups, 84–86

Min er als: in the body, 82; conservation of, 234–235; and crops, 233; in decayed plants, 222; in food, 83; inside homes, 208; maps and, 260–262; in mosses, 27–28; as nutrients, 82; as parts of rocks, 207, 209–210; recycling of, 234; in soil, 220–221, 227; from worms, 33

Mouth: a part of the digestive system, 57, 65, 70, 72; lined with epithelial tissue, 54; food broken down in, 70

Mu cus [MYOO-kuhs], 64

Mus cle [MUHS-uhl] **tis sue:** one of the largest groups of tissue in the body, 54

Mus cles: 55; in the esophagus, 71; and exercise, 89; in the eyes, 170; kinds of, 54, 68; and minerals, 82; and protein, 79; roundworms in, 32

Near sight ed. *See* Eyes, problems with.
Nerve tis sue: one of four main groups of tissues in the body, 56
Nerves: 56; and vitamins, 83
Neu tral [N(Y)OO-truhl]: neither acidic nor basic, 228–229
New ton, Sir Isaac, 159–161
Ni tro gen [NY-truh-juhn]: a gas found in the air, 221, 233
Nose, 54, 64
Nu tri ents [N(Y)OO-tree-uhnts]: the parts of foods which cells use, 76–79, 82–84

Opaque [oh-PAYK]: does not allow light to pass through, 149, 154
Op tic nerve: the nerve which carries messages from the eye to the brain, 170
Op ti cal il lu sion, 177–181
Or gans: a group of tissues that are joined and work together, 57 / as a part of the circulatory system, 60–62; as a part of the digestive system, 70–74; and fats, 77–78; as a part of the respiratory system, 64–68
Ox y gen [OK-sih-juhn]: a gas found in the air, 52, 64 / in air sacs, 66; and algae, 22; in the blood, 61, 63; circulatory system and, 59; minerals and, 82

Pan cre as [PANG-kree-uhs], 72–73
Par al lel cir cuit: a circuit with more than one pathway through which electricity can flow, 111–112
Par al lels [PAR-uh-lehlz]: lines drawn east and west on maps, 254–255
Par a me cium [PAR-uh-MEE-sh(ee-)uhm], 16
Pho tog ra pher, 188
Pig ments, 164, 166
Pla nar i an [pluh-NAR-ee-uhn], 29–30
Plants: 199; acids and, 200, 228; on rocks, 200; in soil, 221 - 222, 224, 228; soil colour and, 227; uses of, 219
Plas ma [PLAZ-muh]: a clear, yellow fluid which is part of the blood, 59
Plates: the large pieces of rock which make up the crust of the earth, 203–204, 216
Pol len [POL-uhn]: a part of a flower which is needed to make seeds, 39
Pow er, 102–103, 124
Pow er plant, 104–105
Pres sure: a kind of force often caused by weight, 203–204, 211, 216
Prime me rid i an: the meridian marked 0° on a map, 255
Prism [PRIHZ-uhm], 159–161
Pro teins [PROH-TEENZ]: a nutrient used by the body cells for growth and repair, 79
Pro to zo ans [PROHT-uh-ZOH-uhnz]: tiny, one-celled animals, 15–16 / in food chains, 19, 22; harmful, 19, 38; helpful, 19; where found, 18
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Red blood cells: the part of the blood which carries oxygen, 59
Ref er ence lines, 254
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Re pro duce [REE-pruh-D(Y)OOS], 10, 17, 24
Re spi ra to ry [REHS-p(uh-)ruh-TOHR-ee] **sys tem:** the system of the body in

which oxygen is taken in and carbon dioxide is given off, 64–66 / food and, 68, 70
Ret i na [REHT-uhn-uh]: the inside wall of the eye, 170–171, 175–176, 182–183
Rocks: 195; acid and, 198–199; formation of, 210–216; freezing water and, 201; importance of, 206; layers of, 202–203; makeup of, 207; plants on, 200; soil and, 220; waves and, 197; wind and, 201

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Sal i vary [SAL-uh-VEHR-ee] **glands,** 70, 72
Scales: maps and, 250–251, 271
Sed i men ta ry [SEHD-uh-MEHNT-uh-ree] **rock,** 211–213, 216
Se ries cir cuit: a circuit which has one pathway through which electricity can flow, 109–111
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Small in tes tine: an organ which is part of the digestive system, 71–74
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Spec trum, 160–162, 164
Spi ders, 40–43
Spores [SPOH(U)RZ]: the tiny cells from which new fungi grow, 24, 27
Stom ach: an organ which is part of the digestive system, 53–55, 57, 71–72, 83
Sub sti tutes [SUHB-stuh-T(Y)OOTS]: and minerals, 235
Sun light, 17, 146–147, 159–163, 165, 235
Sur vey ors [sur-VAY-urz], 278
Switches, 115–120
Sym bols [SIHM-buhlz]: signs used in place of words on maps, 246–248
Sys tem: a group of organs working together, 58–74, 157

Ter mite [TUR-MYT], 18–19
Tis sue [TIHSH-OO]: a group of body cells of the same kind working together, 52–57
Tra chea [TRAY-kee-uh]: a tube leading from the throat to the lungs, 64–65
Trans lu cent [tran(t)s-LOOS-uhnt]: scatters light as it passes through, 150, 154
Trans par ent: allows light to pass straight through, 150, 154

Veg e ta ble- fruit group: one of the four basic food groups, 84–85, 87
Veins: blood vessels that carry blood from the capillaries to the heart, 62–63
Vil li [VIHL-EYE], 73–74
Vi ta mins: a kind of nutrient which helps the body work properly, 83–84
Volt: a measure of electric force, 125

Wastes: the parts of food and air which living things cannot use / in capillaries, 63; carbon dioxide from cells, 66; circulatory system and, 59; from the large intestine, 74; from the small intestine, 74; in soil, 224
Wa ter: and body wastes, 74; electricity and, 105; freezing, 200–201; as a lens, 152; light and, 150–151; power from, 235; as a prism, 161; rock formation and, 210–211; rushing, 196, 220, 232–233; in the sky, 165; in the soil, 221–222, 227; and taking care of the eyes, 184
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TEACHER'S MANUAL FOR

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Introduction to
THE LAIDLAW EXPLORING SCIENCE PROGRAM

Objectives of the program

THE LAIDLAW EXPLORING SCIENCE PROGRAM has been designed and developed to provide pupils with relevant, effective learning experiences in both the knowledge and processes of science. These learning experiences are presented in such a way that all teachers can be effective teachers of science. To help you and your pupils reach these goals, the authors and editors have selected the following objectives for the program:

- ► to provide an exciting study of science by appealing to pupil interest and curiosity;
- ► to develop up-to-date science concepts and understandings that are meaningful in the lives of pupils;
- ► to provide ample opportunities for pupils to explore science through easy-to-do, "hands-on" activities utilizing familiar situations and simple, everyday materials;
- ► to help pupils become skillful in using the processes of science;
- ► to integrate skills and concepts of the biological, physical, and earth-space science areas as well as skills and concepts of other disciplines;
- ► to provide a basis for the development of positive values and attitudes toward science in people's everyday lives;
- ► to help pupils gain an awareness of the importance of their environment and its protection;
- ► to develop an awareness of career opportunities in science.

The following objectives reflect the concerns of teachers as to differences among pupils, cost and availability of materials, preparation time, and knowledge of science:

- ► to provide effective learning experiences for pupils with different interests and abilities;
- ► to utilize inexpensive materials that are common to the home or classroom for activities;
- ► to require preparation time and a background in science that are realistic for most elementary teachers.

Rationale and approach

A considerable part of the pupils' everyday life involves science in one way or another. Using this rationale, the authors and editors have approached science through situations and materials that are familiar to the pupils. Because of this approach, THE LAIDLAW EXPLORING SCIENCE PROGRAM relates to the everyday life of the pupils. The following characteristics of the program reflect this general rationale and approach:

Activity oriented. Each level of the program incorporates a "hands-on" approach using familiar, everyday materials in easy-to-do activities. In this way the pupils explore, discover, or verify concepts and ideas about objects and events. The illustrations and text material support and guide the pupils in performing and interpreting these activities.

Integrated science. The program integrates the skills and concepts of the biological sciences, physical sciences, and earth-space sciences. Because the program approaches science as part of the pupils' everyday life, multidisciplinary relationships occur naturally. Skills and concepts related to health, safety, math, music, history, art, language arts, geography, and other disciplines are integrated with science throughout the program. As a result, the pupils begin to look at the world in fresh, new ways.

Informal, highly visual style. The Laidlaw Exploring Science Program stimulates and maintains pupil interest through a direct, informal writing style and the use of full-color illustrations. The photographs and drawings have been selected not only for visual appeal but also to help explain, clarify, and provide greater insight. The informal writing style and full-color illustrations help create a program with which the teacher and pupils feel comfortable.

Use of humor. Another integral part of the rationale and approach is that a science program can be fun. Humor is effectively used to create interest and to involve pupils. For example, a cartoon based on an amusing incident is used to help introduce each unit. Humor is occasionally used to develop a concept within a unit, also.

Widening experiences. As brought out, The Laidlaw Exploring Science Program consists primarily of science which is part of the pupils' everyday life. However, the program also takes the pupils beyond this point. This is done by including certain science topics that are significant but may not be of an everyday nature. Many illustrations also serve to widen the scope of the pupils' science experiences. Because of these aspects of the program, the pupils are stimulated and aided in exploring the unknown and unusual.

Organization and content

The authors and editors have carefully structured the books to provide a consistent, functional organization which enhances effective teaching and learning. Timely and important content areas, such as the environment and its protection, are included in each book.

Units. There are six units in each book of The Laidlaw Exploring Science Program. Each unit explores a different topic of interest and importance to pupils. Balanced coverage of the life sciences, the physical sciences, and the earth-space sciences is maintained by having two units devoted to each of these three areas in each book. This carefully balanced content enables pupils to study the major areas of science every year. As pupils grow and mature from year to year, the content changes accordingly, taking into account the pupils' abilities, understandings, experiences, interests, and reading level.

The units can be studied in any order. Each unit is a self-contained teaching and learning unit. This adds a dimension of flexibility to the use of the program.

Chapters and chapter sections. Each unit is divided into chapters. The chapters aid in comprehension by breaking the unit topic into smaller teaching and learning packages.

The content of each chapter is organized by sections. The sections help outline the chapter content, further enhancing understanding of the chapters.

Processes of science

Inherent in any type of learning experience —whether it is in science, health, math, or any other area—are certain processes of learning. In science, these processes are sometimes referred to as inquiry skills.

The Laidlaw Exploring Science Program provides many opportunities for pupils to develop skill in using the processes of science. These opportunities are presented throughout the text, illustrations, and special features of the program, especially each of the "Finding Out" activities.

For ease of identification and reference, a list of these processes, or inquiry skills, and a description of each have been included on the next page.

Observing. Using the senses—seeing, tasting, touching, hearing, and smelling—to find out about objects or events in the environment

Comparing. Recognizing ways in which objects or events are alike or are different

Classifying. Grouping objects or events according to their observed characteristics

Measuring. Finding out about an unknown quantity by comparing it with a known quantity

Using numbers. Applying the operations of counting and measuring to objects or events under observation or study

Using spatial relationships. Perceiving and describing objects in terms of their shape, motion, position, or location

Communicating. Conveying information by means of oral or written descriptions, pictures, graphs, charts, maps, demonstrations, etc.

Collecting data. Combining as many processes as necessary to obtain information about objects or events

Inferring. Figuring out a conclusion based on observations of an object or event

Interpreting data. Explaining the meaning or the significance of information regarding an object or event

Predicting. Describing in advance the outcome of an event or process based on observations or data

Hypothesizing. Arriving at general statements of concepts from observations and data

Experimenting. Designing and carrying out procedures to obtain reliable information about interrelationships between objects and events

Role of the teacher

For as many teachers of science that exist, there are at least the same number of science teaching methods. A method that works for one teacher may not work for another. Therefore, to be effective, each teacher must develop his or her own method of teaching science. The pupils' text and the Teacher's Edition have been designed to support and assist you in teaching and in developing a method of teaching science which is effective and enjoyable. Some of the general ideas that follow may also be of help to you.

Inquiry techniques. When teaching science, there has been a tendency for some teachers to feel that their role was mainly to dispense knowledge and answer questions. As a result, the teachers—rather than the students—did most of the work. It is often more effective for teachers to take on a different role, one in which they facilitate pupil inquiry.

To facilitate pupil inquiry, it is important for you to create an atmosphere of exploring, investigating, and finding out. To do this, you might pose interesting objects or problems for your pupils to investigate. During investigations, you might ask key questions now and then to stimulate investigation. You might also encourage your pupils to ask questions and have them try to find answers to their questions. You and your pupils may find that some questions have many answers and that others have no answers at all! These things will help keep your science lessons interesting and open-ended.

Flexibility. Another idea which may be helpful to you in developing an effective science teaching method is to try to remain flexible. For example, you may wish to follow the sequence of units as they appear in the program. Or, you may wish to vary the sequence according to the seasons to capitalize on pupil interest or availability of materials.

In addition to using the unit-opening cartoon to introduce a unit, you may want to make use of an interesting demonstration or bulletin-board display. Another area in which being flexible is often important is the degree to which your science lessons are activity oriented. It is reasonable that you may want to make use of many activities for some lessons, but mainly use the text and illustrations for others.

To help enrich the concepts and activities in a unit, you may want to make use of community resources such as museums, factories, or parks. The possibilities are endless!

Intuition as well as logic. Another important point to keep in mind is that it is equally important for pupils to develop intuitive thought processes as well as logical thought processes. Intuitive thought processes are those processes that involve calculated guesses, hunches, and ideas such as "What would happen if I tried this?"

Most scientists agree that after all calculations have been made and all logical ideas have been pursued, it is often an intuitive process that brings the final solution to a problem. Pupils sometimes need a chance to manipulate or "play" with an object or a problem with no specific or immediate goal in mind. Pupils will often intuitively come up with questions, ideas, or solutions of their own. Through these experiences, they may begin to gain an awareness and appreciation of the aesthetics—the sheer beauty—in science.

Features of
THE LAIDLAW EXPLORING SCIENCE PROGRAM

Basic features

The features of THE LAIDLAW EXPLORING SCIENCE PROGRAM have been developed and designed to excite pupils about science by providing high interest, visual appeal, involvement, relevancy, and success for pupils. These features can be categorized as basic features which permeate the entire program or as special features designed primarily for organizing and emphasizing content and activities. This section describes the basic features of the program.

Illustrations and format. Perhaps the most obvious features of the program are the colorful illustrations and the open, uncluttered format. These two visual features create an attractive, appealing invitation to study science.

The illustrations are not only an important source for interest and appeal but they are also valuable aids to learning. Each illustration has been carefully selected for the purpose of helping to explain, clarify, add new meanings, or provide greater insight.

Many of the captions for the illustrations are in the form of inductive questions that further involve pupils in the content and in the processes of science. The many illustrations which depict children in familiar situations help pupils recognize that science is a part of their everyday life.

"You" approach. To further the pupils' feeling of involvement, the text has been written using the "you" approach. The authors and editors have written the text as if they were speaking directly to each pupil.

In-text questions. Not only does the text involve the pupils personally, but it also elicits responses from them by means of frequent questions. Most of the questions are inductive questions. They help the pupils relate their experiences and the ideas presented in the text to the total concept being developed. Some of the questions involve the pupils' opinions or feelings.

Vocabulary. The use of unfamiliar words has been kept to a minimum. However, if a word important to the understanding of a concept is unfamiliar, the word is *italicized* for emphasis and defined in the text. These words are usually followed by a phonetic respelling to aid in pronunciation and understanding.

Readability. To help ensure ease of reading, the vocabulary and sentence length in each book of the program has been controlled according to the formula that was applicable, either "The Spache Readability Formula" or the Dale-Chall "A Formula for Predicting Readability." Furthermore, extra space has been inserted between words to help ensure ease of reading.

The special consideration given the program's readability to ensure pupil success and interest is further emphasized by these previously mentioned basic features:

- a clear, direct writing style;
- illustrations that help pupils visualize topics and concepts;
- an open, pleasing format;
- a "you" approach that makes use of pupils' experiences;
- in-text questions to involve pupils;
- in-text definitions and phonetic respellings of new or difficult words.

Metric measurements (S1) are used throughout the program. Metric symbols and terminology are based on the *Metric Style Guide* and the *Metric Practice Guide.*

Special features

A variety of interesting and effective special features appear throughout the program. These special features are designed to help organize and present the content and activities of the program.

Unit introduction. A colorful, two-page introduction for each unit is designed to stimulate pupil interest and to focus on the topic of the unit.

The first page contains the unit title, chapter titles, and a colorful illustration. The illustration is made from three-dimensional artwork and carries the theme of the unit.

The second page contains an imaginative, full-color cartoon. The cartoon is followed by questions which help focus attention on the unit topic.

Chapter introduction. Each chapter begins with a brief written introduction. The introduction helps the pupils focus on the chapter topic and helps relate the chapter topic to the pupils' own experiences. Most of the written introductions are accompanied by a color illustration.

Descriptive headings. For ease of understanding, descriptive headings and subheadings are used to organize the text. The headings and subheadings appear in heavier type than the text. Many of them are written as questions or catchy phrases to add interest to the text. Also, the headings and subheadings enhance understanding and interest by dividing the text into smaller "thought packages."

"Finding Out." In THE LAIDLAW EXPLORING SCIENCE PROGRAM an activity feature, titled "Finding Out," occurs frequently throughout each book. Each of these activities provides opportunities for pupils to gain "hands-on" experiences and to use the processes of science. The concepts developed in the text are enhanced and extended through these activities.

Each "Finding Out" begins with a question that correlates the activity with a concept in the text. Next, the materials needed for the activity are listed. These consist of simple, inexpensive materials commonly found in the school or home. The simple setup is clearly illustrated and the steps for carrying out the activity are clearly and simply stated. The activity also includes questions which ask the pupils to explain their findings or relate their findings to the concept being developed. Many times, suggestions which open end the activity are also given.

A few dimensions of flexibility in this feature are of particular note. Each "Finding Out" activity has been designed so that it can be carried out by individual pupils, by small groups, or by the entire class. Substitutes for materials listed in the activity can often be used. For example, the pupils may want to use glass jars instead of milk cartons if they are more readily available or if the pupils think they will give better results. Even some of the steps can be altered to fit the situation or the interests of the pupils.

"***For You to Think About.***" This feature appears in the side margin. It poses one or more questions which are designed to elicit the pupils' opinions or feelings about something developed in the text. Or, the pupils may be asked to make an inference, interpret data, or formulate a hypothesis regarding something developed in the text.

"***Exploring on Your Own.***" The text often touches on many ideas that could be pursued beyond the intended scope of a unit. This special feature encourages pupils to pursue these ideas through their own research.

This feature appears in the side margin and contains a statement or two explaining a possible idea for research in connection with the corresponding text. This feature may also contain suggestions on how to carry out the research, such as doing in-depth work at the library, talking with people who use science in their jobs, or doing simple outside investigations.

"***A Second Look.***" Each chapter ends with a short list of review questions. This feature, titled "A Second Look," enables the pupils to check their understanding of the important facts and concepts of the chapter before continuing on to the next chapter.

"***Workers Who Use Science.***" As part of the concern for the total development of the pupils, the authors and editors have incorporated this career-oriented feature into the program. This feature appears at the end of each unit and relates and applies the main concepts of a unit to a particular field of work. This feature also describes how the work of people in this field is important to other people.

"Workers Who Use Science" contains a full-color photograph of a particular worker in action. It also includes questions about the worker and possible sources for finding answers to these questions.

The main purpose of this feature is to help create in pupils an awareness of possible career opportunities in their future. Careers which require a minimum of training are described as well as those that require college degrees.

"***Reviewing the Main Ideas.***" The end of each unit also contains a list of the main ideas of the unit. This list provides the teacher and pupils with a handy tool for reviewing the main concepts developed in the unit.

"***Reading About Science.***" The next feature at the end of each unit is a bibliography for the pupils. Suggestions are given for further reading about topics in the unit. The bibliography at each level offers reading materials appropriate for the age, grade level, and interests of the pupils.

"***Testing for Understanding.***" This feature of the program provides a quick way of checking the pupils' understanding of the important ideas and words of the unit. The first part of the feature, subtitled "Ideas to Check," contains a list of statements for the pupils to designate as either true or false. The second part of the feature, subtitled "Words to Use," contains a list of incomplete statements. The pupils are asked to complete the statements using the appropriate word or words from a list of choices given.

"Having Fun with Science." This feature appears on the last page of every unit. It provides opportunities for the pupils to reinforce and extend some of the concepts of the unit by means of fun-type activities. The activities are easy to carry out and appear under many different subtitles, such as "Brainteasers," "What Am I?" "Fun with Words," and "Things to Do."

"Glossary-Index." A combined glossary and index is provided at the end of each book. The purposes of the "Glossary-Index" are to help the pupils pronounce and understand certain words in the book and to help the pupils find out about topics in the book that may interest them. The "Glossary-Index" also contains an explanation of the phonetic respelling system used in the book.

For ease of identification, the words which are listed in the "Glossary-Index" appear in boldface type. The page numbers on which the words appear are also included. Cross-references are given when considered beneficial.

Teacher's Edition for
THE LAIDLAW EXPLORING SCIENCE PROGRAM

Purpose and physical features of the Teacher's Edition

The purpose of the Teacher's Edition for THE LAIDLAW EXPLORING SCIENCE PROGRAM is to provide you, the teacher, with a variety of teaching aids which you can use conveniently and efficiently. The Teacher's Edition has been designed to help you guide your pupils in developing science concepts with ease and confidence.

The Teacher's Edition consists of full-color reproductions of each page from the pupils' text with extended bottom margins followed by a twenty-four page Teacher's Manual. The printed copy and illustrations from the pupils' text appear in the same size in the Teacher's Edition as in the pupils' text to help ensure ease of reading.

The inclusion of the pupils' pages makes it possible to easily point out something on the page for your pupils. The extended bottom margins make it possible to have a variety of specific teaching helps immediately available on the lesson page. Teaching helps which appear on the reproduced pupils' pages are printed in blue for easy identification. The Teacher's Manual contains information to help you understand and use all the components of the program effectively.

The sturdy wire binding of the book allows you to handle and use the Teacher's Edition easily and conveniently.

The Teacher's Manual

The twenty-four pages which follow the reproduced pupils' text are referred to as the Teacher's Manual. The Teacher's Manual contains information to help you understand and effectively use THE LAIDLAW EXPLORING SCIENCE PROGRAM. The Teacher's Manual consists of the sections that follow.

***Introduction to* THE LAIDLAW EXPLORING SCIENCE PROGRAM.** The objectives and approach of the program are presented with related science and science-teaching background information. Organization and content are also discussed.

Features of THE LAIDLAW EXPLORING SCIENCE PROGRAM. The features of the program are described, and the function of each feature is explained.

Teacher's Edition for THE LAIDLAW EXPLORING SCIENCE PROGRAM. Each feature of the Teacher's Edition is described. Suggestions as to how you can use each feature in teaching are explained.

Instructional Materials. This section consists of an annotated bibliography of instructional materials. The listing includes printed materials, films, and recorded materials. These instructional materials are categorized as general references or as materials appropriate for a particular unit.

Unit Tests. Suggested tests for each unit are provided in this section.

Answers for Unit Tests. Answers or sample answers for the Unit Test questions are listed in this section.

Features appearing in the extended bottom margins

A wide variety of teaching helps are conveniently located in the extended bottom margins of the Teacher's Edition.

Preparing for the unit. This feature appears on the first page of each unit. It contains page references for books, films, and recorded materials listed in the "Instructional Materials" section of the Teacher's Manual that are appropriate for use with the unit.

A list of the page reference for each "Finding Out" activity in the unit is also included. This provides an opportunity to have your pupils collect, in advance, the materials needed for each activity.

Introducing the unit. The second page of each unit contains suggestions for using the unit-opening cartoon and questions to help introduce the unit to your pupils.

Main concepts of the chapter. The main concepts of each chapter are concisely summarized on the first page of each chapter. This helps you see at a glance the main ideas to emphasize in teaching the chapter.

Performance objectives. Also appearing on the first page of each chapter is a list of performance objectives. The objectives state in behavioral terms the main things your pupils should be able to do after they have completed the learning experiences provided in the chapter. The objectives are simply stated and can be used to help establish cognitive goals with your pupils.

Important words. The important words of each chapter are also listed on the first page of each chapter. You may wish to use this list to emphasize certain words that are important in understanding the main concepts of the chapter and in strengthening science vocabulary.

Suggested activity, discussion, or research. Very often throughout a unit, suggestions for enriching a section of the pupils' text are given. These suggestions may be ideas for a simple activity, a thought-provoking discussion, or interesting research. Sometimes, a combination of suggestions is given, such as "Suggested activity and discussion" or "Suggested discussion and research."

Teaching helps for "Finding Out." This feature appears on each page that has a "Finding Out" activity. The teaching helps are divided into sections. The first section, titled "Processes used," contains a list of the science processes that your pupils will develop and utilize during the activity. A list of these processes and their description appears on page T5 of the Teacher's Manual.

Another section, "Sample findings," describes what your pupils may find out while doing the activity. Of course, your pupils' findings may go far beyond those given. However, being aware of some of the possible findings in advance can help you in guiding the pupils in their activity and discussion.

The two sections described above appear in each of the "Teaching helps for Finding Out." Two other sections which sometimes appear in this feature are "Additional information" and "Extending the Finding Out." "Additional information" may provide helpful hints for carrying out the activity. Or, it may provide background information helpful in explaining the findings. "Extending the Finding Out" contains suggestions for expanding the "Finding Out" or carrying out another activity related to the "Finding Out."

Teaching helps for pictures. The illustrations throughout each chapter are designed to help develop the concepts of the chapter. On many of the pages, specific teaching helps for using a picture are given.

Sample answers for various features. Many of the features of the program, such as "For You to Think About," are designed to elicit responses from the pupils. Of course, your pupils' responses may vary, and in many instances there are no right or wrong answers. The purposes of listing sample answers are to alert you to the kinds of answers your pupils are likely to give and to help you in guiding the discussion of the various features.

Sample answers for the following features appear in the bottom margins: questions below the unit-opening cartoon, "For You to Think About," captions for illustrations, "A Second Look," and "Workers Who Use Science." Answers for various sections of "Having Fun with Science" are given when called for.

Sample findings for "Exploring on Your Own." Also included in the bottom margins are sample findings that your pupils will most likely discover when they carry out research in the feature "Exploring on Your Own." The sample findings are designed to help you verify the pupils' findings without performing the research yourself.

Reviewing the unit. This feature appears on the first color-tinted page at the end of each unit. It encourages you to have your pupils study the list of main ideas of the unit on that page in order to review the unit and prepare for "Testing for Understanding."

For further reading. This feature also appears on the first color-tinted page at the end of each unit. It gives suggestions for encouraging your pupils to use the bibliography on that page to further explore various aspects of the unit topic.

Suggestions for evaluation. This feature appears on the same page as "Testing for Understanding" at the end of each unit. It contains suggestions for utilizing the test questions on that page for evaluating your pupils' progress. It also tells you where in the Teacher's Manual additional test questions (and their answers) for the unit can be found.

For further involvement. This feature appears on the last page of each unit. It offers suggestions for encouraging your pupils to carry out the activities in "Having Fun with Science" on that page and other fun-type activities which help reinforce some of the concepts developed in the unit.

Features appearing in the side margins

The wide side margins of the pupils' page provide space to conveniently include the teaching helps that follow.

Sample answers. Throughout the pupils' text are many questions for your pupils to think about and answer as they read the material. To help you keep a smooth flow of discussion in your classroom, sample answers to these questions are provided for you in the side margins as close to the questions as possible. Though there are often many possible answers to these questions, the sample answers are intended to alert you to the kinds of answers that are acceptable and help you keep your pupils within the main theme of the material being developed.

The questions and their corresponding answers are marked by superscript numbers for ease of identification. In the few places where there is not enough space in the side margin for sample answers, they appear in the bottom margin.

Answers for Testing for Understanding. The answers to the test questions at the end of each unit appear next to the questions. This makes it quick and easy for you to check your pupils' progress at the end of each unit.

Instructional Materials

General references

Blough, Glen O., and Schwartz, Julius. *Elementary School Science and How to Teach It.* Toronto, Ontario: Holt, Rinehart and Winston, 1974.

This fifth revision provides up-to-date information on the different subject areas of science taught at the elementary level.

Gega, Peter C. *Science in Elementary Education,* 3rd edition. Rexdale, Ontario: John Wiley & Sons, 1977.

This book provides a comprehensive explanation of how to teach elementary science. Part I introduces science organization, strategies, evaluation, and lesson planning. Part II contains model lesson plans that encourage children to learn through the development of their own critical thinking skills.

Whitla, Dean K., and Pinck, Dan C. *Lively Elementary Science Programs: A Handbook of Suggestions for Introducing and Maintaining Science Activities.* Office of Instructional Research and Evaluation, Faculty of Arts, and The Harvard Graduate School of Education, Harvard University, Cambridge, Massachusetts, 1974.

This handbook contains many useful activities for all levels of elementary education.

Unit 1 Small Living Things (pages 6 – 47)

Reference materials

Elementary Science Study: Behaviour of Mealworms. Scarborough, Ontario: McGraw-Hill Ryerson.

This guide contains a series of interesting investigations that may be done with mealworms.

Moelling, F. K. *Beginning with the Microscope.* Don Mills, Ontario: Saunders of Toronto, 1972.

The structure, function, and care of the microscope are carefully explained. This book will assist teachers in using the microscope to help in the study of small living things.

Science 5/13 Series: Minibeasts. Agincourt, Ontario: GLC Publishers, 1973.

This teacher resource book contains many practical and stimulating ideas on small living animals.

Schwartz, George I., and Bernice S. *Food Chains and Ecosystems.* Toronto, Ontario: Doubleday Canada Ltd., 1974.

This book provides resource materials for studying plant and animal ecosystems. Experiments, fieldwork, sources of supply, and resource books are included for the science teacher.

Filmed or recorded materials

"Community Food Energy Flow," filmstrip, 55 frames, 11 minutes. Don Mills, Ontario: Educational Film Distributors.

"The Fantastic World of Insects, Parts A and B," filmstrips, with records or cassettes. Scarborough, Ontario: E.T.H.O.S.

"Life of the Honeybee," filmstrip, 38 frames. Don Mills, Ontario: Educational Film Distributors.

"Marvels of the Hive," film, 20 minutes. Don Mills, Ontario: Educational Film Distributors.

"Organisms Living Together in Communities," filmstrip, 50 frames, 10 minutes, with record or cassette. Don Mills, Ontario: Educational Film Distributors.

"The Pond," filmstrip, with record or cassette. Toronto, Ontario: Visual Education Centre.

"Simple Plants," filmstrip, with record or cassette. Toronto, Ontario: Visual Education Centre.

"Spider Ecology" and "What is a Spider?" filmstrips, with records or cassettes. Scarborough, Ontario: E.T.H.O.S.

Unit 2 Your Body (pages 48 – 95)

Reference materials

Jones, Kenneth L., Shainberg, Lewis W., and Byer, Curtis O. *The Human Body*. San Francisco, California: Canfield Press, 1971.

This book is a handy reference guide to the structure and function of the organs and systems of the human body.

Science 5/13 Series: Ourselves. Agincourt, Ontario: GLC Publishers, 1973.

This teacher resource book contains many practical and unique activities and ideas for classroom use.

Filmed or recorded materials

"The Human Digestive System," 39 frames. "The Human Respiratory System," 32 frames. "The Human Nervous System," 47 frames. Filmstrip series. Don Mills, Ontario: Educational Film Distributors.

"Menu," film, 22 minutes. Toronto, Ontario: National Film Board.

Unit 3 Electricity on the Move (pages 96 – 143)

Reference materials

Elementary Science Study: Batteries and Bulbs, 2nd edition. Scarborough, Ontario: McGraw-Hill Ryerson.

This guide provides numerous activities for classroom use.

Doyle, John M. *Foundations for Electronics*. Toronto, Ontario: Holt, Rinehart & Winston, 1972.

This book provides a comprehensive coverage of the theory and application of electric circuits. Some topics include currents and voltage, resistance, and electric circuits.

Filmed or recorded materials

"Electric Circuits and How They Work," filmstrip, 58 frames, 12½ minutes, with record or cassette. "How Electricity Is Produced," filmstrip, 61 frames, 11 minutes, with record or cassette. "Light and Heat from Electricity," filmstrip, 54 frames, 12½ minutes, with record or cassette. Don Mills, Ontario: Educational Film Distributors.

"Making Electric Currents," "Power for Us" and "We Use Electricity," filmstrips, with records or cassettes. Agincourt, Ontario: Cinemedia.

Unit 4 Light (pages 144 - 191)

Reference materials

Elementary Science Study: Optics. Scarborough, Ontario: McGraw-Hill Ryerson.

This guide presents a number of interesting activities in the study of the properties of light.

Mueller, Conrad G., and Rudolph, Mae. *Light and Vision.* Agincourt, Ontario: GLC Publishers, 1966.

This is one in the excellent series, the *Life Science Library.* This book discusses light, colour, vision, and the workings of the human eye.

Science 5/13 Series: Coloured Things, Stages 1 and 2. Agincourt, Ontario: GLC Publishers, 1973.

This teacher resource book contains many practical activities and ideas on light and colour.

Filmed or recorded materials

"Finding Out About Light," filmstrip, 46 frames. Don Mills, Ontario: Educational Film Distributors.

"Introduction to Light," filmstrip, 67 frames, 12 minutes, with record or cassette. Don Mills, Ontario: Educational Film Distributors.

"Separation of Colours," filmstrip. Toronto, Ontario: National Film Board.

"Understanding Colour—Colour by Addition," film, 14 minutes. Toronto, Ontario: City Film.

Unit 5 The Changing Land (pages 192 - 239)

Reference materials

Elementary Science Study: Rocks and Charts, 2nd edition. Scarborough, Ontario: McGraw-Hill Ryerson.

This guide provides a number of activities in the study of rocks.

Sorrell, Charles A. *Minerals of the World—A Guide to Field Identification.* Cambridge, Ontario: Whitman Golden, 1973.

Colour photographs, diagrams, and other illustrations of the minerals of the world are provided in this book. It includes an introduction to geology for the teaching of minerals.

Vita-Finzi, Claudio. *Recent Earth History.* Rexdale, Ontario: John Wiley and Sons, 1973.

This is a study of the earth in the last 20,000 years from organic and inorganic records. Coverage includes information for geology, geography, and archaeology in the classroom.

Filmed or recorded materials

"Maps—Land Symbols and Terms," film, 14 minutes. Toronto, Ontario: City Film.

"The Rise and Fall of the Great Lakes," film, 17 minutes. Toronto, Ontario: National Film Board.

Unit 6 Mapping the Earth (pages 240 – 281)

Reference materials

Elementary Science Study: Mapping. Scarborough, Ontario: McGraw-Hill Ryerson.

This guide provides a number of mapping activities that may be done in the classroom.

Skelton, R. A., David Woodward, ed. *Maps: A Historical Survey of Their Study & Collecting.* Chicago, Illinois: University of Chicago Press, 1972.

This book is a guide to maps. It includes their importance throughout history, how they are made, and their importance to earth studies.

Filmed or recorded materials

Exploring the World of Maps, "The Message of Maps," "Using Maps," "The Round Earth on Flat Paper," "Surveying the Earth," and "The Making of Maps," films, 11 – 14 minutes each. Toronto, Ontario: Visual Education Centre.

"Every Square Inch," film, 23 minutes. Toronto, Ontario: National Film Board.

"Latitude," film loop. Toronto, Ontario: City Film.

"Longitude," film loop. Toronto, Ontario: City Film.

Unit Tests

Purpose of the tests

Tests for each of the six units of this book are provided on the pages that follow. These tests are designed to assist you in evaluating your pupils' progress in learning and applying the important words and main concepts for each unit.

Ways of testing

Depending on your teaching approach for each unit, you might choose to use these tests to evaluate your pupils in various ways. A unit test might be used as a pretest/posttest. That is, the test might be given to your pupils before they begin a unit. Then, you might wish to give the test again after the pupils have completed the unit. In this way, you may compare the results to help you in evaluating the pupils' progress.

You might wish to use these unit tests only as posttests. After the pupils have completed a unit, you may wish to give these tests in lieu of or in addition to "Testing for Understanding" found at the end of each unit in the pupils' text.

Duplicating the tests

You are granted full permission to duplicate these tests for your classroom use. If duplicating machines are not available in your school, you are granted full permission to rewrite these tests in the form which can most easily be presented to your pupils.

Test answers

Space has been provided for answers to be written on these tests. For any short-answer or essay-type items, your pupils may need extra space to write their complete answers. For such items, you might have the pupils use the reverse side of the test or an extra sheet of paper.

Answers to each unit test are provided on the Teacher's Manual pages immediately following the last unit test. Answers to the matching, sentence completion, and true-false questions are listed numerically with their letter answer.

Answers to the essay questions are presented in a short, concise form. Your pupils' answers to these questions will, of course, vary from the exact terminology of the sample answers. It is up to your discretion to weigh each of the pupils' answers and to judge their acceptability.

Scoring the tests

Each unit test has a total score value of 100 points. The point value for each question is given with the directions for each part of the test. Some questions have a greater point value than others. By totaling the number of points for each section, you can determine the final score and record it in the space provided at the top of each test.

Name ______________________________ Score __________
(100 points total)

Test Questions for Unit 1 Small Living Things

(Textbook pages 6–47)

Circle the letter for each best answer. (7 points each)

1. Bacteria are made up of
   a. tiny animal food chains.
   b. a colony of protozoans.
   c. just one cell each.

2. A colony is
   a. the green colour in plants.
   b. a group of living things.
   c. the main thread of a spider.

3. Chlorophyll can help plants
   a. make their own food.
   b. reproduce spores.
   c. decay in soil.

4. A mushroom is a kind of
   a. fungi.
   b. bacteria.
   c. moss.

Write the letter for the correct group in front of each small living thing in column I. Choose your answers from column II. (7 points each)

I	II
_____ 5. amoeba	a. fungi
_____ 6. beetle	b. insects
_____ 7. black widow	c. protozoans
_____ 8. cockroach	d. spiders
_____ 9. vinegar eel	e. worms
_____10. mushroom	

Write your answer below each of the following questions. If you need more space, write on the back of this sheet or on another sheet. (15 points each)

11. Name three places where bacteria may be found.

____

12. Why is an antiseptic put on a cut?

____

Name ______________________________ Score __________
(100 points total)

Test Questions for Unit 2 Your Body

(Textbook pages 48–95)

Circle the letter for each best answer. (5 points each)

1. Tissues are made up of
   a. organs.
   b. cells.
   c. systems.

2. Your heart is part of your
   a. respiratory system.
   b. digestive system.
   c. circulatory system.

3. Carbohydrates are a kind of
   a. blood cell.
   b. nutrient.
   c. protein.

4. Vitamins are found in
   a. certain foods.
   b. epithelial tissue.
   c. the air.

Write the letter for the correct system in front of each body part in column I. Choose your answer from column II. (5 points each)

I	II
_____ 5. salivary glands	a. circulatory system
_____ 6. blood	b. digestive system
_____ 7. bronchial tubes	c. nervous system
_____ 8. capillaries	d. respiratory system
_____ 9. diaphragm	
_____10. spinal cord	
_____11. heart	
_____12. liver	
_____13. lungs	
_____14. brain	

List each of these foods under the proper food group. Write on the back of this sheet or on another sheet. (2 points each)

bananas, butter, cheese, chicken, crackers, eggs, ham, hamburgers, ice cream, muffins, noodles, oranges, peanuts, pears, potatoes

Milk Group	Vegetable-fruit Group	Bread-cereal Group	Meat Group

Name ________________________________ Score ____________
(100 points total)

Test Questions for Unit 3 Electricity on the Move

(Textbook pages 96–143)

Circle the letter for each best answer. (5 points each)

1. Things through which electricity does not flow are called
   a. circuits.
   b. conductors.
   c. insulators.
   d. switches.

2. Electricity which moves along wires is called
   a. static electricity.
   b. current electricity.
   c. a fuse.
   d. lightning.

3. Tiny particles which may cause things to become charged are
   a. electrons.
   b. circuits.
   c. volts.
   d. batteries.

4. To prevent fires caused by electricity, many homes have
   a. kilowatt hours.
   b. circuit breakers.
   c. magnets.
   d. conductors.

Write the letter for the correct word in front of each definition in column I. Choose your answers from column II. (5 points each)

I

_____ 5. electricity which is not moving
_____ 6. a form of static electricity
_____ 7. combines picture and sound signals
_____ 8. source of electricity
_____ 9. things through which electricity can flow
_____10. any pathway for electricity
_____11. two pathways for electricity
_____12. can turn electricity on and off

II

a. battery
b. circuit
c. conductors
d. television
e. lightning
f. parallel
g. static
h. switch

Write your answer below each of the following questions. If you need more space, write on the back of this sheet or on another sheet. (20 points each)

13. What are five ways you can be careful with electricity?

____

14. How are television programs brought to your home?

____

Name ______________________________ Score __________

(100 points total)

Test Questions for Unit 4 Light

(Textbook pages 144–191)

Fill in the letter of the word that best fits in each blank below. Choose from the list of words that follows. (5 points each)

a. complementary
b. spectrum
c. afterimage
d. cornea
e. image
f. iris
g. lens
h. shadow

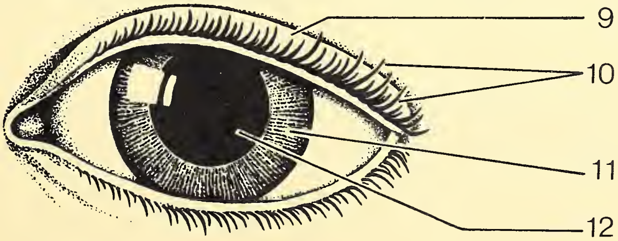
1. When light does not pass through opaque things, a ----- is made.
2. Magnifying glasses are made with a convex -----.
3. When light bounces from a mirror, you are able to see your -----.
4. Light travels through a prism and breaks into a band called a -----.
5. The------- is the coloured part of the eye.
6. Any two colours of light that form white when they are mixed are called-------colours.

Write your answer below each of the following questions. If you need more space, write on the back of this sheet or on another sheet. (15 points each)

7. What are five things you can do to help take care of your eyes?

8. What are some problems in seeing and how can they be corrected?

Name the parts of this eye. (10 points each)



9. ------------------------------
10. ------------------------------
11. ------------------------------
12. ------------------------------

Name ______________________________ Score __________

(100 points total)

Test Questions for Unit 5 The Changing Land

(Textbook pages 192–239)

Circle the letter for each best answer. (5 points each)

1. A slow folding and cracking of the earth's crust is a
   a. mineral.
   b. fault.
   c. sedimentary.
   d. mantle.

2. The center part of the earth is known as the
   a. core.
   b. mantle
   c. crust.
   d. humus.

3. Prints of once-living things found in rocks are
   a. acids.
   b. fossils.
   c. volcanoes.
   d. minerals.

4. Sometimes heat causes part of the mantle and core to be
   a. sedimentary.
   b. limestone.
   c. molten.
   d. hard.

Write the letter for the correct word in front of the definition in column I. Choose your answer from column II. (5 points each)

I

----- 5. rests on the core
----- 6. can dissolve rocks
----- 7. makes up rocks
----- 8. decaying plants and animals
----- 9. sedimentary rock
-----10. dinosaur bone
-----11. igneous rock
-----12. metamorphic rock

II

a. acid
b. fossil
c. granite
d. humus
e. limestone
f. mantle
g. marble
h. minerals

Write your answer below each of the following questions. If you need more space, write on the back of this sheet or on another sheet. (20 points each)

13. What are three forces which can change the surface of the earth? Explain how these forces can change the surface of the earth.

----

14. Explain two ways soil can be conserved.

Name ______________________________ Score __________

(100 points total)

Test Questions for Unit 6 Mapping the Earth

(Textbook pages 240–281)

Circle the letter for each best answer. (5 points each)

1. The height of an area of land is called the
   a. elevation. c. scale.
   b. symbol. d. legend.

2. A large area drawn on a small map is drawn to
   a. reference. c. scale.
   b. elevation. d. meridian.

3. Lines drawn on a map to help you find places are called
   a. grids. c. legends.
   b. symbols. d. scales.

4. The list of symbols used on a map is the
   a. grid. c. legend.
   b. equator. d. parallel.

Write the correct letter in front of each definition in column I. Choose your answers from column II. (10 points each)

I	II
_____ 5. prime meridian	a. equator
_____ 6. where a lettered line and a numbered line on a map cross	b. International Date Line
_____ 7. divides the earth into north and south	c. legend
_____ 8. lines which run north and south on a map	d. meridians
_____ 9. lines which run east and west on a map	e. parallels
	f. reference point

Write your answer below each question. If you need more space, write on the back of this sheet or on another sheet. (15 points each)

10. What are four things which make up the language of maps?

----

11. Sam got on a plane and traveled for 50 minutes in the air. When he got off, he looked at a calendar in the airport. He had arrived a day before he had left. What happened?

Answers for Unit Tests

Unit 1 Small Living Things

1. c 2. b 3. a 4. a 5. c
6. b 7. d 8. b 9. e 10. a
11. In air, food, water, and people's bodies.
12. It helps kill bacteria.

Unit 2 Your Body

1. b 2. c 3. b 4. a 5. b
6. a 7. d 8. a 9. d 10. c
11. a 12. b 13. d 14. c

Milk Group	Vegetable-fruit Group
butter	bananas
cheese	oranges
eggs	pears
ice cream	potatoes

Meat Group	Bread-cereal Group
chicken	crackers
ham	muffins
hamburgers	noodles
peanuts	

Unit 3 Electricity on the Move

1. c 2. b 3. a 4. b 5. g 6. e
7. d 8. a 9. c 10. b 11. f 12. h
13. When my hands are wet, I should never touch electrical things.

I shouldn't put any objects into an electrical outlet.

I shouldn't turn on too many appliances at one time.

I should never touch a fallen electrical wire outdoors.

I should not experiment with electricity from an outlet at home or school.

14. Special cameras take motion pictures of the show. These pictures are changed into one kind of electric signal. The sound picked up by microphones is changed to another kind of electric signal. These two signals are then combined to make the TV signal. The TV signal travels by waves through the air. When the TV set is turned on, the TV signals are changed back to pictures and sound.

Unit 4 Light

1. h 2. g 3. e
4. b 5. f 6. a
7. Visit an eye doctor for regular checkups.
Never rub my eyes.
Read or watch television in good lighting.
Wear sunglasses when in bright light.
Close my eyes to rest them after I read for a long time.
8. Nearsightedness and farsightedness. People who are nearsighted or farsighted can wear glasses to correct their vision.
9. eyelid 10. eyelashes 11. iris
12. pupil

Unit 5 The Changing Land

1. b 2. a 3. b 4. c 5. f 6. a
7. h 8. d 9. e 10. b 11. c 12. g
13. Wind, waves, and rain. Wind can blow small pieces of sand against rocks which can cause small pieces of rock to break off. Waves can pick up rocks and cause them to grind against each other which makes them break down. Rain contains acid which can cause rocks to dissolve.
14. Soil can be conserved by replanting trees and grass in areas where the land has been cleared. Soil can also be conserved by planting a different kind of crop in the same soil each year and by adding fertilizer to the soil.

Unit 6 Mapping the Earth

1. a 2. c 3. a 4. c 5. b 6. f
7. a 8. d 9. e
10. Symbols, colors, scales, grids.
11. Sam traveled from east to west and crossed the International Date Line.

Teacher's Notes

Teacher's Notes

DATE DUE SLIP

JAN 26 RETURN	DUE EDUC JAN 29'87
DUE EDUC APR 13'89	DUE EDUC APR 03'9
APR 09 RETURN	MAR 28 RETURN
DUE EDUC OCT 17'89	NOV 24'93
OCT 18 RETURN	1993 NOV 12 RETURN
DUE EDUC NOV 02'89	DUE EDUC NOV 27'93
NOV 01 RETURN	DUE EDUC DEC 11'93
DUE EDUC MAR 04'90	DUE EDUC DEC 29'93
FEB 21 RETURN	1993 DEC 19 RETURN
DUC NOV 04'90	DUE EDUC DEC 02'95
OCT 23 RETURN	RETURN NOV 21'95
NOV 22'91	RETURN SEP 19'99
DEC 06'91	RETURN NOV 24'99
NOV 25 1991 RETURN	RETURN NOV 29'99

F255

F. 255

DUE EDUC MAR 06'89

MAR 10 RETURN

JAN 24 1984

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